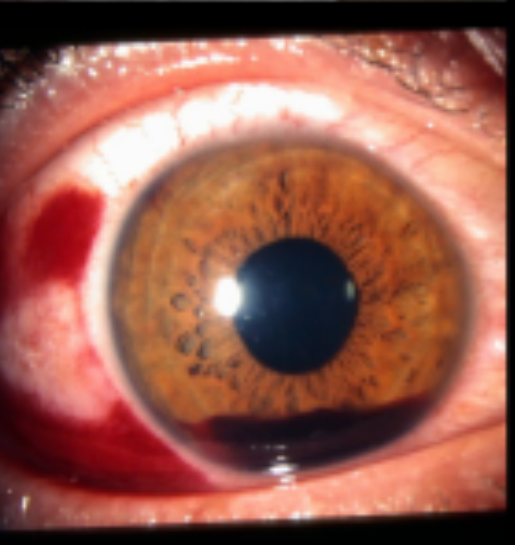

Survival & Austere Medicine

An introduction

3rd Edition — 2017

Written and Edited by the
Remote, Austere, Wilderness & Third World Medicine
Discussion Board Moderators

Survival and Austere Medicine: An Introduction

Third Edition

Written and Edited by The Remote, Austere, Wilderness and Third World Medicine Discussion Board Moderators

December 2017

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Any constructive comments and debate are welcome. We welcome correction in any errors of fact. Despite our best efforts we realise there will be some errors of fact. We apologize for any errors of grammar or spelling they are entirely ours.

Our goal is to update this version in the next 18-24 months if possible – if you would like to help contribute or edit that version please contact us at the websites on page 22.

Contributors and Editors: This book is a combined effort. The primary chapter writers are credited, but there have been many contributions within chapters from others. We have also had editorial assistance and constructive comment from many others whose efforts we greatly appreciate. We also thank all the contributors and editors from the last edition.

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READ THIS FIRST!

Disclaimer: The editors and authors accept no responsibility for the use or misuse of this information. The practice of medicine is something that should only be undertaken by trained professionals. If you start administering medical or surgical treatments without the appropriate skills you will kill someone. Even in emergency situations often no action is better than uninformed and untrained action. Any practice of survival medicine should be backed up with appropriate training. Much of this information is offered to give you a perspective of what may be possible in a long term catastrophic disaster or when working in an austere or remote environment without access to organized or trained medical care – we in no way endorse practicing these techniques except in such a situation. This information is offered as personal opinions and should not be taken to represent a professional opinion or to reflect any views widely held within the medical community. Appropriate additional references should be consulted to confirm and validate the information contained in this book.

Trust but verify. "Доверяй, но проверяй"

Russian folk proverb

Conversion Formulas

Throughout this book, we have attempted to use both metric and US standard measurements, but realize we have not always succeeded. Below you will find useful conversion formulas for units of measure.

Length

1cm = 0.3937 inches

_____ cm x 0.3937 = ____ inches

(Note 1cm = 10mm)

Weight

1kg = 2.2 lbs

___kg ÷ 2.2 = ____ lbs

Temperature

(__°F – 32) ÷ 1.8 = ___°C

__°C x 1.8 +32 = __°F

Background

This book is a major revision of the Second Edition of a book of the same name published in 2005 – every chapter, bar one (the Herbal medicine chapter – which has been left alone as a tribute to its original author who has died since last edition) has been substantially rewritten and updated.

In turn the second edition was a major revision of the Survival Medicine FAQ's (Frequently Asked Questions), which were originally written for the misc. survivalism Usenet newsgroup in 1997. It was written in response to recurring posts asking the same questions and the fact that many answers were often wrong and occasionally dangerous.

While the original content of the FAQ and the subsequent edition remains valid, we thought it was time it underwent an update again. We hope you will find it useful. It is offered in good faith but the content should be validated and confirmed from other sources before being relied on even in an emergency. It is a tool to help you with medical care in an austere or 'grid-down' environment.

When the original FAQ and previous edition were written, there were very few books aimed at the "Practicing Medicine after the End of the World as We Know It" market – however over the last couple of years several books of varying quality have been published, offering information on this topic.

We like to think we are the original "Medicine at the End of the World" guide and our uniqueness in the current market place comes from our history and that it is the collaborative work of a group of experienced medically orientated preppers and survivalists. Between us, we have extensive experience in pre-hospital, austere, remote and third world medicine – both with the military and NGO's. We do this stuff – we understand the limits of the environment and the issues of supply and improvisation. We have trained lay people to do complex medical procedures and provide health care in their remote communities. We have undertaken community medical needs assessments and the delivery of health care after natural disasters. We have given anaesthetics and done surgery in tents in the back of beyond. While the shit hasn't hit the fan in Western Countries yet, you don't have to look far to find accurate analogies to likely Collapse Medicine and between us we have experience working in these locations and situations. This makes our book unique.

The other unique fact about this book is that it remains free! It's a labour of love for us and we have enjoyed the comradery of putting it together. We are passionate about helping to improve the neglected 'Band-Aid' bit of the "Beans, Bullets and Band-Aid's" mantra common in prepper and survivalist circles. We have spent countless hours on this book project, not to make money, but to genuinely improve people's levels of medical preparedness.

While a formal print copy is available at cost, the *PDF is freely available to download provided the key aspects of the copyright notice are adhered to and left intact.

It is not designed purely as a "how to do x" reference – although there is some of that. There are plenty of books, which tell you how to practice medicine. This book is designed to bridge the gap between a conventional medical textbook to an austere or survival situation and to provide some answers to commonly asked questions relating to survival/preparedness medicine and to also provide relevant information not commonly found in traditional texts or to direct you to that information.

We have tried to minimise technical language, but at times this has not been possible, if you come across unfamiliar terms – please consult a medical dictionary.

The original authors and editors are passionately committed to helping people develop their medical knowledge and skills for major disasters. We hope you find it useful

Web Site:

For errors, questions and comments the authors can all be contacted via posting at the following websites:

"The Remote, Austere, Wilderness and Third world Medicine Forum"

http://medtech.syrene.net/forum/

or at reddit

https://www.reddit.com/r/AustereMedicine/

We welcome discussion and debate.

If you are interested in improving the 4th edition and have a passion for this type of medicine come by for a chat.

Medicine at the End of the World

With no antibiotics, there would be no treatment for bacterial infections; pneumonia or a simple cut could kill again, contagious diseases (including those sexually transmitted) would make a comeback, and high mortality rates would be associated with any surgery. Poor hygiene and disrupted water supplies would lead to an increase in diseases such as typhoid and cholera. Without vaccines, there would be a progressive return of infectious diseases such as polio, tetanus, whooping cough, diphtheria, mumps, etc. especially among children. People suffering from chronic illnesses such as asthma, diabetes, or epilepsy would be severely affected with many dying (especially insulin-dependent diabetics). There would be no anaesthetic agents resulting in a return to torturous surgical procedures with the patient awake or, if they were lucky, drunk or stoned. The same would apply to painkillers; a broken leg would be agony, and dying of cancer would be distressing for the patient and their family. Without reliable oral contraceptives or condoms, the pregnancy rate would rise and with it the maternal and neonatal death rates, women would die during pregnancy and delivery again, and premature babies would die. Women would still seek abortions, and without proper instruments or antibiotics death from septic abortion would be common again. In the absence of proper dental care teeth would rot, and painful extractions would have to be performed. What limited medical supplies available would have to be recycled, resulting in increasing risks of hepatitis and HIV infection.

The practice of medicine would go back 200 years.

Chapter 1: The Context of Survival and Austere Practice

There is a sense, when considering the issues around survival medicine practice, that everything is overwhelming, that it is impossible for lay people to provide a high level of medical care and maintain a high level of population health.

We don't think this is the case at all. We believe that intelligent lay people with some basic medical knowledge, skills, and equipment can deliver high quality health care. While it is obviously impossible for lay people to safely and competently deal with every medical problem, and there remain many complicated diagnoses requiring equally complicated or technologically advanced treatments, for 80-90% of the health problems afflicting humanity, simple things done well are all that is required to preserve life and limb and help alleviate suffering.

Consider the following:

1. Remote Medicine Practice:

Below are the results of one of our author's experience in the provision of health care in various remote and austere locations (some third world, some first world) to nearly four thousand people over a cumulative 30-month period (spread over 18 years) – with more data there are few minor changes from the 2005 2nd edition, but the list is essentially the same – which is interesting. The record keeping was a bit unreliable at times, but the following summary is reasonably accurate.

Top 20 presentations (representing > 95% of consultations):

1. Minor musculoskeletal injuries - ankle sprains most common, included many minor fractures which didn't require more than diagnosis and simple care
2. Upper respiratory tract infections
3. Allergic reactions/Hay fever/Anaphylactic reactions/Rashes
4. Minor open wounds – included a mix of lacerations needing closure, many needing cleaning and advice only, and some infected wounds
5. Gastroenteritis/Vomiting/Diarrhoea
6. Mental health problems
7. Sexual health/Contraceptive problems
8. Skin infections/Cellulitis
9. Dental problems
10. Abdominal pain - 4 confirmed acute appendix (2 treated with IV antibiotics and subsequent delayed appendix removal / 2 required evacuation) + 1 gangrenous gall bladder. Many were "no cause found". Of the remainder with a clear diagnosis the most common were renal or biliary colic)
11. Fever /Viral illness
12. Chest infections
13. Major musculoskeletal injuries (fractures/dislocations)

14. Asthma
15. Ear infections
16. Urinary tract infections
17. Burns – mostly partial thickness within the realms of management in the environment the patient was in. Several required evacuations. Several required rehabilitation due to location and sub-optimal initial treatment.
18. Chest pain
19. Syncope/Collapse/Faints
20. Early pregnancy problems

Major trauma was uncommon but was seen including several fractured femurs and a dozen cases of multi-system severe trauma resulting in a mix of in-country surgery and evacuations

Top 12 prescribed drugs (representing >90% of medications prescribed):

1. Paracetamol (Acetaminophen)
2. Loratadine (and other assorted antihistamines)
3. Diclofenac (and other assorted antiinflammatories)
4. Combined oral contraceptive
5. Flucloxacillin
6. Throat lozenges
7. Augmentin (Amoxycillin + clavulanic acid)
8. Loperamide
9. Nystatin (and other antifungals)
10. Hydrocortisone cream
11. Ventolin inhalers (Salbutamol / Albuterol)
12. Morphine

What is of note here is that the clear majority of problems dealt with are simple and straight forward – there is still potential for serious consequences but there is scope for a well-informed lay person with a basic knowledge and access to a reasonable collection of reference books to provide reasonable care. Equally the vast majority of medication prescribed are from a very narrow well defined list – despite the fact 1000's of drugs are on the market – the list of core lifesaving or comfort preserving ones is relatively brief.

2. Why children die

The World Health Organization (WHO) has identified the following conditions as having contributed to >75% of worldwide deaths in the under 5-year age group (in no particular order):

Pneumonia

Pneumonia is an infection of lungs. Prevention of this condition is somewhat limited – although good nutrition, clean and warm housing, and a reduction in the exposure to respiratory irritants (smoke) all can help. However, the most common bacteria which cause pneumonia are frequently sensitive to penicillin – which is discussed later in the book and can be produced in a low-tech environment.

Diarrhea

Death from diarrhea (dehydration) is almost 100% preventable with appropriate use of oral rehydration therapy. Dirty water or poor food handling causes much diarrhea – this can be virtually eliminated by proper hygiene practices and care with drinking water.

Pre-term delivery

While we are limited in the direct interventions available in an austere environment to mitigate this problem contributing factors to early labor are young age, malnutrition, smoking, poor maternal health, so there is scope for indirect intervention based on optimizing mum's health and environment. For babies who are born prematurely the necessities of life are warmth and breast milk. With attention to detail for both things, it is possible for infants as young as 33-34 weeks to survive without high-tech intervention.

Malaria

Prevention is better than a cure, knowledge about clearing stagnant water, mosquito nets and long sleeved clothes can significantly reduce the risk. Equally quinine is derived from the bark of the Chincona tree and the Chinese have been using the herb, Artemisinin, effectively for the treatment of Malaria for years. So, while not as easy to treat or prevent as diarrhea, there is still scope for significant reduction in death rates in low-tech ways.

Blood infection

Blood infection or septicemia is rapidly fatal. The ability to intervene depends on the cause of the infection and antibiotics available. Broadly, infections causing septicemia can originate from the skin, the lungs, the kidneys or bladder, and the abdominal contents. While specific treatments for these may be lacking in an austere environment – all have prevention strategies and basic low-tech treatments that can be lifesaving when applied appropriately.

Lack of oxygen at birth

Of these problems, this is the one with probably the least scope for impact. Unfortunately, even if foetal distress is detected during labor (with heart beat monitoring or signs of distress like meconium), without the ability to deliver the baby quickly options are limited. That said, a caesarian section is not a massively complicated operation (and discussed in Chapter 10), and in parts of the third world is performed by trained lay people with safety and success.

Measles

Again, there is limited scope to intervene directly with the disease. Measles is always around and while vaccination reduced the incidence of epidemics, sporadic cases still occur. In the absence of vaccinations epidemics of measles every few years will be inevitable. There is however some scope to minimize the spread during an epidemic with isolation and respiratory precautions during outbreaks. While some of the serious neurological complications are unavoidable in a

small number of patients, basic care such as maintaining hydration can also prevent complications such as dehydration.

Neonatal tetanus

The prevention of neonatal tetanus is easy. You don't let the site where the umbilical cord attaches to the baby get dirty. It is as simple as that.

HIV/AIDS

Prevention of maternal infection is the key to prevention of infection of newborns. The steps required to prevent exposure to the HIV virus are widely known: abstinence (not undertaking sexual activity), monogamy (maintaining a single sex partner rather than multiple) and if neither is a palatable option, then safe sexual practices.

Most the conditions above have an element of either preventability or the ability to be treated to some degree in an austere environment and significant improvements in mortality and morbidity can be made.

3. The greatest advances in medicine

Several years ago the British Medical Journal ran a poll trying to identify top medical advances of the last 200 years. The following is the top 12 from that poll:

Sanitation	1st
Antibiotics	2nd
Anaesthesia	3rd
Vaccines	4th
DNA	5th
Germ theory	6th =
The oral contraceptive	6th =
Evidence based medicine	8th
Imaging	9th
Computers	10th
Oral rehydration therapy	11th
Smoking cessation	12th

Just as with our discussion above about the causes of childhood deaths, this list is introduced to show just how much impact a very basic health care knowledge can have in terms of optimising health in a post-disaster or austere situation.

Of the biggest advances of medicine in the last 200 years, between 7 to 9 (depending on your knowledge and available resources) of the 12 can be applied to care in a austere situation. In particular, the knowledge of sanitation, germ theory, oral rehydration therapy, and simple manufactured antibiotics and anaesthetic agents all have the potential to be able to be continued to be applied in a post-disaster situation and to continue to contribute to a high quality of low-tech health care. In the same way that we can substantially reduce childhood death rates in a low tech post-disaster situation, we can still continue to have access to some of the biggest advances in medicine even at the end of the world.

4. Surgery in the third world

A non-specialist surgeon working at a isolated bush hospital in Papua New Guinea published his experience of Emergency Surgery over a 14 month period (similar articles have been published with similar data):

Emergency Surgery	**243**
Tendon repair	33
Open orthopaedics	32
Dilation and curettage	31
General surgery	29
Incision and drainage	26
Laceration repair	26
Obstetrics	23
Manipulation under anaesthesia	15
Urology	15
Gynaecology	9
Ear, nose and throat	2

Emergency anaesthesia	243
Ketamine – spontaneous breathing	166
Local anaesthesia	33
Ketamine – ventilated	16
Spinal anaesthesia	12
Propofol / thiopentone	10
Epidural	5
Epidural / GA	1

The point of this reference is to help illustrate what someone can achieve in primitive conditions with no formal surgical training and no dedicated anaesthetist. We are not suggesting that the average layperson can safely practice to this extent or breadth of surgery, but it does demonstrate that a non-surgeon can achieve much. It also shows that most anaesthetics for surgery in an austere situation can be done under local or ketamine anaesthetics.

Why this is relevant?

Each of these four references gives you insights, one way or another, into low-tech austere health care. First, it gives you an insight into the likely clinical problems that you may see in a survival situation, and how much can be dealt with in that sort of austere environment. Second, it demonstrates how medically speaking it is the small things and simple knowledge which save lives and some of the biggest killers can be mitigated with these relatively low level interventions or strategies.

In our opening summary – "Medicine at that end of the world", we describe a pretty bleak medical reality post-SHTF. Will million's really die from lack of access to modern heath care as we have alleged?

The short answer is yes – many will die much sooner than they otherwise would have, from disease and injury, which currently are not immediately fatal. But the answer is not nearly that simple nor bleak. The reality is that while cancer, diabetes, malnutrition or serious injury may claim many of its victim's sooner than with today's health care, most health problems can be treated or mitigated to a degree in a low-tech environment, with a narrow range of medications and interventions – including some cancers, non-insulin requiring diabetes and many major traumatic injuries.

Most medical problems are relatively mundane and not life threatening. Truly catastrophic problems in medicine are fortunately rare. You should focus on learning and preparing to deal with the common problems, and doing common procedures well, and you will save lives, and possibly also improve the quality of those lives.

There will be a significant change to health care but with knowledge and some preparation it isn't quite as dire as many (including our own opening paragraph) predict.

Perhaps the single most important piece of advice in this book:

While the focus of this book is on practicing medicine in an austere environment it does not address one key area which must be considered as part of your preparations: That is optimizing your health prior to any disaster; losing weight, keeping fit, maintaining a healthy diet, and managing any chronic health problem aggressively. Stop smoking. Drink less. Look after your teeth. These topics are well covered in 100s of books about getting fit and staying healthy, but if you do not take some action in this regard all your other preparations may be in vain when you drop dead of a heart attack from the stress of it all. Not only will this benefit you, but also the lives of many others whom you aim to help!

Chapter 2: What Do I Need to Know and How Do I Learn It?

Core Knowledge

The more you learn the better!
The sooner you start the better!

Start off learning basic first aid. Then try and learn as much anatomy and physiology as possible –A & P are the building blocks of medicine. Once you understand how the body is put together and how it works, you are in a much better position to understand disease and injury and apply appropriate treatments. Then you should try and obtain some more advanced medical education and practical experience.

There is no syllabus that we can list that will tell you what you need to know to cover every possibility – medicine is vast and has become super specialized – but as we discussed in the introduction – a solid grounding in some simple knowledge and skills can deal with a large percentage of most common medical issues.

Table 2.1 contains some core knowledge, which should be considered fundamental to anyone assuming responsibility for providing medical care to a group.

While having a list of core knowledge is helpful. Ultimately what you need to be able to do is: "Know how to perform a basic assessment, established a rough working diagnosis, and know where to look to find further information about what to do next." The fact you don't know all the fine print doesn't matter, the key is having a rough idea of what is going on, and knowing where to look to find out more, and ensuring you have the references available.

Medicine is dangerous, and uninformed decisions and actions will kill people. Despite having said that a lot of medicine is simply common sense. Anyone with a bit of intelligence, a good A&P book, and a good basic medical text can easily learn the basics. The ideal is a trained health care professional and anything else is taking risks, but in a survival situation any informed medical care is better than no medical care. Please note we say informed; if you really don't have a clue what you are doing you will be very dangerous.

Formal Training

Professional medical training: The gold standard option is undertaking college study in a medical area e.g. Medicine, Nursing, Physician's Assistant, Paramedic, Vet, etc. This clearly isn't an option for many, but it is still the best option and should be clearly identified as such.

Other formal training options by region:

Note. In the following sections a few commercial courses are mentioned. We have no financial interest in any of these courses. While we have heard positive things about the commercial courses mentioned we do not offer any endorsement of any course or any warranty as to the quality of the teaching provided. Times change and good things can and do go bad. When looking at a course look in detail at what is being covered (e.g. is it a national standard? Does it cover what you need to know?) And who are the instructors? (Do they have credibility? What are their backgrounds?)

Table 2.1 Core Knowledge and Skills to Aim For

- Use a good medical dictionary and a basic medical textbook to answer questions – know where to look to find answers to things you don't know.
- Know how to take a patient history and perform a simple examination (including vital signs)
- Know basic first aid and resuscitation skills
- Perform basic bandaging and dressings, clean a wound, debride a burn.
- Use local anaesthetic to numb a wound.
- Suture a wound, but also know when not to suture a wound, and leave it open or perform a delayed closure.
- Deliver a baby and afterbirth. Suture a vaginal tear, manage a post-partum bleed.
- Reduce and immobilise a short and long bone fracture/dislocation.
- Use basic counselling skills.
- Understand basic hygiene and preventive medicine practices.
- Recognise and treat common infections:
    - Viral flu
    - Upper respiratory tract infections
    - Pneumonia
    - Urinary infection
    - Wound or skin infection
    - Common STD's
- Recognise and treat common medical and surgical problems:
    - Asthma/respiratory distress
    - Serious causes of chest pain
    - Abdominal pain – renal (kidney) stones/appendix/biliary stones
    - Allergic reactions/anaphylaxis
- Look after someone who is bed bound, e.g. basic nursing care, managing the unconscious patient, elimination, nutrition.
- Use basic dental skills, simple fillings, infections, and extractions.
- Insert an IV and understand basic fluid resuscitation.
- Learn how to insert an indwelling urinary catheter and look after it
- Learn how to insert a nasogastric tube and look after it
- Improvise medical equipment and supplies.

This list is probably the minimum standard to aim for – it provides an overview of anatomy and physiology, and an introduction to the basics of looking after sick and injured patients. It is based around delivering the patient to a hospital as a result so is of limited value in remote and austere medicine – but it provides a solid introduction. More importantly – it is easily and safely learnable by a lay person.

United States:

EMT Basic:

This is the national standard for providing Emergency care in the USA. The courses follow a curriculum set out by the US Dept. of Transportation. They are offered by many community colleges. While in theory the content is the same, there is wide variation in quality of teaching over different sites. The best feedback you are likely to get will come from previous students. The course length is usually several hundred hours. This is probably the minimum standard to aim for – it provides an overview of anatomy and physiology, and an introduction to the basics of looking after sick and injured patients. It is based around delivering the patient to a hospital so as a result it is of limited value in remote and austere medicine – but it provides a solid introduction.

Additionally, the US recognizes various levels of EMT, which we will generically call Intermediate and Paramedic;

EMT-Intermediates are generally allowed to initiate venous access and to administer a modest array of emergency drugs, use esophageal and supra-glottic airways, and use automated defibrillators. Patient assessment skills are also more developed than with the EMT-B or First Responder. Overall training is approximately 400 hours in addition to the pre-requisite EMT-Basic course.

EMT-Paramedics constitute the highest level of training for most states. In addition to all previous skills accorded EMT-Bs and Is they may make use of a significantly larger array of medications including gaseous analgesia, paralytics and amnesiacs. They may also perform airway intubation via direct visualization, perform 12-lead interpretive EKGs, and in some jurisdictions, are trained as community health providers able to perform immunizations, reduce minor dislocations, and perform simple wound closure.

First Responder: If you are unable to undertake an EMT-B course, this provides the "lite" version. Covering similar material in much less detail it is a good start but not overly in-depth. The usual course length is 40-80 hours – most quality schools offer a 60+ hour course. Various community education groups offer the course and the Red Cross also offers a variation.

The next level down from first responder is a standard "First Aid" course offered by the Red Cross and many other organisations

***EMT/Wilderness EMT Course*:** For most this is a much more realistic option than formal college training. These courses give a basic background in anatomy and physiology, medical terminology, and the essentials of emergency medicine. It provides the basis for additional self-directed learning. Most community colleges offer these courses. The basics are well covered in the "first responder"/First Aid courses, which although very elementary, provide a good stepping stone to the more advanced courses while not requiring the same time commitments as a full EMT courses.

Tactical EMS: There are several courses available which focus on tactical EMS – the provision of emergency care in hostile environment and for prolonged periods. Frequently they have a prerequisite of at least EMT-B and usually some practical experience in a tactical environment. However, some provide more entry-level courses. The focus of these courses is primarily on trauma and combat associated injuries. The quality of these courses varies enormously.

The original tactical EMT program was developed by the US Protective Services, Counter Narcotics, and Terrorism program (CONTOM). They offer both basic and advanced EMT-Tactical programs. Typically, they are accessed through law enforcement programs but they will accept direct approaches.

Another highly recommended course is the Operational and Emergency Medical Skills course provided by Deployment Medical International. (http://deploymentmedicine.com/oems-courses/).

Some other providers of these types of courses include:

Insight training http://www.insightstraining.com
HK Tactical Medical Training http://www.tacticalmedicine.com/

Canada

St. John Ambulance: SJA provides the bulk of private first response and basic EMT training in Canada. There are probably several other more advanced courses available but we have had difficulty obtaining information on them.

United Kingdom:

***First Aid Certificate*:** Basic first aid course. This is usually 8-24 hours' worth of instruction. This an excellent place to start for those with minimal experience. It is offered through St. John Ambulance, or the Red Cross, and many commercial providers. If you are a member of either organisation they provide much more comprehensive training up to EMT basic level.

Community First Responder: These schemes are generally administered by the local ambulance service who provide the training and governance. CFR's will be responded by the Ambulance services to sick sounding patients in their area to provide initial resuscitation until the Ambulance arrives. The goal is to get more rapid BLS and defibrillation. One plus of the scheme, depending on the

service, if that you will be equipped with an ambulance response pack and an AED. For relatively little time per month you get good training and access to basic equipment.

BASICS: The British Association for Immediate Care Schemes runs several courses with provide extensions from basic first aid. While not specifically focused on preparedness medicine, they provide an opportunity for non-professionals to obtain teaching up to an EMT-P theory level – although lack the practical hours. They offer the basic Immediate Care course and the more advanced Pre-hospital Emergency Care course. Both are expensive. They are also affiliated with the Faculty of Pre-Hospital of the Royal College of Surgeons of Edinburgh.

Diploma in Remote and Offshore Medicine: Currently in development. Aimed at medics working in the oil/gas industry at remote sites. This will become the gold standard for non-professional people in the UK getting experience for remote or austere medical work. (https://fphc.rcsed.ac.uk/education-resources/remote-offshore-medicine)

EMT / Advanced EMT / Expedition Medicine Courses / Remote paramedic: There is a plethora of different courses offered by many providers across the UK and Eurpoe offering courses aimed at the level above basic first aid – and they are not cheap. There are some good courses out there, but also mixed in are many dodgy ones. The word of mouth of someone you trust is probably the best way to try and find a good course. They offer a variety of additional content from wound care, IV therapy and cannulation, pharmacology and advanced airway management. Looks closely at the testimonials on their web sites – talk to the people quoted and specifically ask about the qualifications of the people doing the teaching. Who recognises the qualification? What is it recognised as – many are simply recognised as a first aid course. What clinical experience do you get? Do they have arranged clinical placements or do you learn everything on a mannequin? It is impossible to take you from a basic first aider to a competent medic on a 3-day course – so you need to suitably sceptical about claims of rapid advancement in a short period. There are some great courses out there – but shop around and let the buyer beware!

We do endorese the charity College of Remote and Offshore Medicine Foundation. www.CoROM.org

Australia / New Zealand:

First Aid Certificate: Similar situation to the UK. Run by St. John, Red Cross, and some private providers.

Wilderness First Responder: This a 10-day course offered by the Wilderness Medicine Institute at various sites around Australia. Not delivered at a particularly advanced level, but goes well beyond a standard first aid course and is focused on remote work. (http://www.wmi.net.au)

Remote Paramedic: This is the industry standard for working in the isolated mines and factories of remote Australia. Some courses are aimed at those starting with a basic first aid level of knowledge, others are assumed to have civilian or military EMT level experience. It offered by a variety of providers

including St John WA http://www.stjohnambulance.com.au/first-aid-training/industry-qualifications and Wilson Medical https://www.wilsonmedicone.com.au/courses/Pages/industrial-health-courses.aspx (links working 12/17)

Informal Training

Emergency Department Observing: It is possible to gain some experience observing or working in an ER. Many Emergency Departments regularly have a variety of people coming through for practical experience from army medics, to off-shore, island, forest service staff, to fishing boat medics. If you can provide a good reason for wanting to gain skills in the emergency room such as "sailing your boat to the South Pacific," then the potential to gain practical experience in suturing, inserting IVs, and burn management is there. In North America, this is more difficult to arrange due to insurance issues. However, if you are not actually going to touch a patient and are just going to be there to observe then if you ask the right people it should be easy to arrange. While not the same as “hands on” experience, simply experiencing the sights and sounds of illness and injury will help prepare you for if you must do it yourself.

Arranged Teaching: Another option is befriending (or recruiting) a health care professional and arranging classes through them. It is common for doctors to be asked to talk to various groups on different topics so an invitation to talk to a "tramping club" about pain relief or treating a fracture in the bush would not be unusual.

Volunteering: Many ambulances and fire services have volunteer sections or are completely run by volunteers. Through these services, you may be able to obtain formal EMT training and at the same time gain valuable practical skills and experience, overcome fear of dealing with acutely sick people and work with some great people. Organisations such as the Red Cross, Search and Rescue units, or Ski patrols also offer basic first aid training, as well as training in disaster relief and outdoor skills. It is also often possible to arrange "ride-alongs" with ambulance and paramedic units as the 3rd person on the crew and observe patient care even if you are not able to be involved.

Some examples of organisations inclide:

http://www.globalmedicalprojects.co.uk/
https://www.volunteerhq.org/
https://www.projects-abroad.org/

Chapter 3: Organisational issues

If you are alone or just a couple then organising your medical care is relatively straightforward. However, the larger the group the more formalised and structured your medical care should be. Someone within the group, ideally with a medical background, should be appointed medic. Their role is to build up their skill and knowledge base to be able to provide medical care to the group. There should also be a certain amount of cross-training to ensure that if the medic is the sick or injured one, there is someone else with some advanced knowledge. The medic should also be responsible for the development and rotation of the medical stores, and for issues relating to sanitation and hygiene. Regarding medical matters and hygiene their decisions should be absolute, and their advice should only be ignored in the face of a strong tactical imperative.

How you deliver care will depend on the size of the group you are looking after. Small groups don't require a formal "sick-call" or clinic time; you provide care when required and fit it in around other jobs. For a larger group dedicated time is required for running clinics and other related medical tasks e.g. public health work and it may be a full-time activity.

In the next few pages we cover some of less obvious, but important concepts around providing health care.

Risk Assessment/Needs Assessment:

As alluded to in the introduction what you plan for depends on what you are worried about. As part of your medical preparations you should undertake a detailed needs assessment. You should ask and answer the following questions (at least):

1. What am I preparing for?
   Natural disasters; Nuclear war; Ice ages; Economic collapse; Peak oil, etc.
2. How many people will I be looking after?
3. What age range will I be looking after?
4. How long will we need to be independent for?
5. What are their pre-existing health problems?
6. What physical condition are they in?
7. What physical environment/climate will I be living in?
   Hot/Cold; Wet/Dry; Underground shelter/above ground, etc.
   Are there any important disease related to environment?
8. What level of medical care can I provide?
9. What additional training do I need? How do I get it?
10. What supplies do I need? How much of each?
11. Do I have sufficient reference books?
12. Have I considered how I will deal with difficult issues relating to practicing medicine: Confidentiality, death and dying, sexuality, scarcity of resources, etc.

Documentation:

Even in a survival situation documentation is important. You should keep a record of every patient you treat. What they complained of, the history and examination, what you diagnosed, and how you managed them, a very clear note of any drugs you administer, and a description of any surgical procedure you perform should all be recorded. Anyone with an ongoing problem should have a chronological record of their condition and treatment over time recorded. There are two reasons for this. First is that for the ongoing care of the patient often it is only possible to make a diagnosis by looking over a course of events within retrospect and it is also important to have a record of objective findings to compare to recognise any changes over time in the patient condition. Second is for legal reasons. When things return to normal it may be important to justify why certain decisions were made. Detailed notes from the time will make this easier. It is also useful to have medical records on members of your group prior to any event including things such as blood groups and any existing or potential medical problems.

One useful method of recording medical information is the S.O.A.P format. It can be used to document every patient encounter. It provides a structure which is easy to follow and understand

S. Subjective
What the patient has complained about and the history associated with it, e.g. a Headache for 2 days with associated fever, nausea, and a stiff neck.

O. Objective
What you find on examining the patient or from your investigations, e.g. a fever of 39 degrees, looks dehydrated and has a purple rash.

A. Assessment
This is your assessment of what is wrong with the patient after your history taking, examination, and investigations, e.g. probably bacterial meningitis

P. Plan
Your management plan for the patient, e.g. IV antibiotics and fluids, isolate from others.

It is easy to follow and provides a consistent format for documentation.

Physical Location:

Where possible you should have a dedicated clinic area. For both functional and infection control reasons, it is worth having a dedicated area.

Key features where possible (and this is a wish list):

Clean – and easy to keep clean
Adequate lighting – both generally and more focused for examinations

Adequate space and storage
Adequate work surfaces and an examination table or bed
Privacy
Access to water – preferably hot
Warm/Dry
Protection from threats – ballistic and environmental

Rationing, Scarcity and Triage:

The persisting survival theme of how you deal with the "have nots" when they approach you applies to medicine as much as to food and other supplies. Obviously complete isolation is one option but this is unlikely to be common. How do you deal with the stranger dumped on you with the gunshot wound or pneumonia? It's one thing to give them a meal, but do you give them the last of your IV antibiotics or your one dose of IV anaesthetic? You need to think about these things in advance. People can often "live off the land," and forage for food but they cannot forage for penicillin. It's also worth considering that these people may be more likely to be in poor general health and carriers of infectious diseases. This raises the question of isolation vs. community involvement again. One possible option may be to quarantine the refugees for a period before any contact with your group. There is no perfect quarantine time frame – but 14 days should cover the clear majority of infectious diseases.

Rationing doesn't only apply externally to your group, it also applies internally. Scarce resources and potentially unlimited demand. This is already common practice within healthcare – health is rationed every single day in some shape or form – anytime demand exceeds supply, there is rationing or triage.

Within civilian peace time ethical values, the approach is simple = the greatest good to the greatest number. If you have the resources that you can save one seriously ill person or ten moderately ill people, the choice is generally clear, you save the 10 moderately ill and the seriously ill patient is allowed to die. These sorts of decisions are made every day in medicine. There is much greater ethical conflict in austere practice - you have very finite supplies but the decision making around who gets what can get very muddy. Do you pour all of your resources into possibly saving your wife/ child /best friend now, who has a 10% chance of survival with maximal therapy or do you save your resources and potentially save 10 other people who have a 90% chance of survival with minimal therapy in the future. The resolution of this ethical conflict is a personal one.

The Doctor/Medic-Patient Relationship:

Another important area is confidentiality and trust. This is the cornerstone of any medical relationship. It may seem an odd thing to mention regarding a preparedness situation but as all doctors, nurses, and paramedics will tell you, without trust you can't practice medicine. You need to trust that what you tell your medic will go no further, and personal problems won't become dinnertime conversations. Obviously, this must be weighed against the "common good" of the group but unless it would place the group in danger there should be an absolute rule and practice of confidentiality.

The Paradigm of Providing Advanced Care with Limited Knowledge:

This is a concept we first raised in the introduction to this book. It is revisited several times across the book. What if the outcome if you do nothing is death, how much should you do with limited training?

If someone has a gangrenous infection spreading up their leg they will die.
You are not a surgeon, but you are an experienced EMT and you have several good references around how to perform an amputation. Do you, or don't you?

If you act too late the patient will die regardless. If you act prematurely maybe it will settle down – after all you have never seen gangrene before, only read about it and looked at pictures?

There is no right answer. But you need to have thought about how far you will go and under what circumstances. It is one of the fundamental issues of austere or 'grid-down' practice

Checklists:

This ties in closely with the practice of advanced care, with limited knowledge. Most complicated tasks can be simplified down to their key component tasks. By breaking a complicated medical procedure into its constituent parts, it is easier to understand and easier to perform. If you then list each component in a flow chart you can perform the complicated task by completing each of the simpler tasks.

You can break the surgical procedure of removing an appendix down into about 30-35 individual steps – each of which is not overly complicated or beyond an enthusiastic amateur. Sequentially working down the list enables you to perform the much more complicated task in smaller manageable parts – like building Ikea furniture! We are not trying to be glib here, it is important to understand that many relatively complicated things in medicine can be easily broken down into much simpler individual parts.

Writing a checklist immediately before you need to do something is not ideal, but overtime preparing detailed checklists which cover a procedure is not hard. Start with some simple topics – suturing a wound, inserting a nasogastric tube – the basics remain the same regardless.

Create a checklist:
Are the indications met?
Do I have the right equipment?
Is the patient prepared?
Is the patient consenting?
Step 1 of the technical procedure
Step 2 of the technical procedure……
Have I done everything need after the procedure?

A broken-down task and several specific checks to make sure you undertake the task in the right sequence and you don't miss out anything important.

Chapter 4: Medical Kits

What you stock up on should be related to what you know how to use and what you can obtain. There are potentially thousands of drugs and different pieces of medical equipment, and you can't stock everything. Fortunately, it is possible to manage 90% of medical problems with only a moderate amount of basic equipment and drugs. Obviously, the treatment may not be as high quality as that provided by a proper hospital but it may be lifesaving and reduce long-term problems. For example; a general anaesthetic, an operation for an internal tibial nail, followed by pain management, and physiotherapy usually manages a broken tibia in a hospital setting. In a remote austere situation, it can be managed by manipulation with analgesia, and immobilization with an external splint for 6-8 weeks, and as a result the patient may be in pain for a few weeks, and have a limp for life but still have a functioning leg. Appendicitis has been treated with high-dose antibiotics when surgery has been unavailable such as on a submarine or in the Antarctic. Removal of an appendix has been done successfully many times under local anaesthesia – one soviet surgeon has even removed his own appendix under local anaesthetic. Although in each case management maybe sub-optimal and may have some risk in a survival situation it can be done and may be successful with limited medication and equipment.

Photo of Dr Leonid Rogozov removing his own appendix in Antarctica, 1961

It is frequently suggested that you stock up on supplies over your own level of expertise on the chance you may have access at some point to someone more highly qualified. This argument has a degree of merit. There are two problems with this approach. First, often the focus shifts to buying the more

complicated and sophisticated gear while neglecting the basics – it's great to have suture material and instruments, but not if you haven't already got the dressings and bandages sorted first. Secondly, often you are at risk of buying the wrong equipment and supplies. We have reviewed quite a few people's medical kits over the years and its common to see advanced equipment obtained for the "just in case a doctor turns up" scenarios – often its old, inappropriate or broken and its frequently obtained to the detriment of the basics. If you do adopt this approach – cover the basics first and make sure you have the useful and working equipment.

In our view, kit contents should reflect an assessment of individual skills (within a group), activity and environmental risk, population served (size/health), estimated duration of coverage, and how austere you are regarding higher levels of care – or not.

You should think if building your medical kits based on the tasks that you're trying to accomplish. Each electrician will prefer slightly different set of tools in his tool belt and will change his tools slightly based on whether he's working on commercial or residential structures. Similarly, our kits in Medicine are based on what we're working on, the nuances of that job, and our own personal preferences and skill sets. However, there are some core fundamentals (every electrician has a screwdriver for example). Likewise, every medical provider has tape and gauze in their kit regardless of what else.

Obtaining Medical Supplies:

Medications:

Obtaining medications can be difficult. The problem is two-fold. First is access and second is cost. Below are some suggestions for legally obtaining medicines for use in a survival medicine situation.

i. Talk to your doctor. Be honest explain exactly why and what you want, that you want to be prepared for any disaster and have some important basic meds available if medical care isn't freely available. Demonstrate an understanding of what each drug is for and that you know how to safely use it. This approach depends on your relationship with your doctor, and how comfortably you are discussing these issues, although, I would suggest that you don't request narcotics the first time. Then return the meds when they have expired, this will confirm that you are not using them inappropriately.

ii. Discuss with your MD your plans for a trekking holiday. Most MDs recognise the importance of an adequate medical kit if you are travelling in the 3rd world or doing isolated backpacking. Most would prescribe antibiotics, rehydration fluid, simple pain killers, anti-diarrhoea meds, antibiotic and fungal creams, and if climbing, steroids, acetazolamide and furosemide for AMS (although these last 2 have limited roles in a survival situation). It is also worth requesting Malaria prophylaxis – the CDC recommends doxycycline for most regions.

iii. Buy a boat. Australia, New Zealand, and the UK, require all boats sailing beyond coastal limits to carry a comprehensive medical kit. This includes antibiotics, strong narcotic analgesics, and a variety of other meds. Although not a legal requirement in the US, I imagine most MD's would happily equip an ocean-going yacht with a comprehensive medical kit, especially if you can

demonstrate a basic medical knowledge. The US Public Health service offers suggested medications and equipment, depending on numbers and expected isolation.

iv. Prescription medicines are available over the counter in many third world countries. While purchasing them certainly isn't illegal, importation into your own country may well be. While it is unlikely that a single course of antibiotics would be a problem, extreme care should be exercised with more uncommon drugs or large amounts. Narcotics shouldn't be imported under any circumstances. Should you purchase drugs in the third (or second) world you need to be sure you are getting what you believe you are. The best way is to ensure that the medications are still sealed in the original manufactures packaging.

v. "Not for human consumption": Veterinary meds are widely available and are relatively cheap – you can by human grade antibiotics from many fish supply stores. Several books discuss obtaining them (Survivalist Medicine Chest. Ragnar Benson. Paladin Press is one), so I won't cover it in detail here. We cannot recommend this method, but obviously for some it is the only viable option. Most veterinary drugs come from the same batches and factories as the human version, the only difference being in the labelling. This is the case for most common single-component drugs such as antibiotics. If you are going to purchase veterinary medications I strongly suggest only purchasing antibiotics or topical preparations and with the following cautions: (1) make sure you know exactly what drug you are buying, (2) avoid preparations which contain combinations of drugs and obscure drugs for which you can find no identical human preparation and (3) avoid drug preparations for specific animal conditions for which there is no human equivalent. Buy drugs which are generically identical to their human counterparts, e.g. Amoxicillin 500mg (Vet) = Amoxicillin 500mg (Human), etc. You use these at your own risk.

vi. Ask a vet: We have talked about using veterinary medications above. But specifically talking to you DVM is an option. There are some dogs that have recurrent problems treatable with antibiotics - staph skin infections, bacterial gastroenteritis, etc., that vets don't mind an owner keeping drugs on hand to treat. Some may be willing to dispense antibiotics (a short course of metronidazole) if their client is taking a known anxious dog on a trip and may develop antibiotic responsive diarrhoea. You could also try the "camping/long trip away from society" approach as a reason - with a good working knowledge of the drugs. Again, use is at your own risk, but as another option, this is probably more likely to happen at a rural clinic than at a big practice, and like having good rapport with your MD is useful, a good relationship with your DVM helps.

A discussion with a dozen doctors suggests that options ii, iii and iv would be acceptable to most of those spoken to. In fact, many were surprisingly broad in what they would be prepared to supply in those situations. Interestingly, in contrast to when we asked about support for the survivalism/preparedness mindset last time when most considered it unhealthy, – ½ of those we spoke to supported medical preparations for a big disaster, including prescription medication. So it may be that with some doctors, honesty is the best policy.

Other Medical Supplies:

Obtaining general medical supplies is often easier. Basic bandages, and stethoscopes, etc. can be bought from any medical supply house or on eBay. In the USA, there is no federal law prohibiting the purchase of things like sutures, syringes, needles, IVs, etc. but some states can make it difficult. In most other countries, they are freely available. Try looking in the yellow pages for medical, or emergency medical supply houses, or veterinary supplies. Several commercial survival outfitters offer first aid and medical supplies; however, I would shop around before purchasing from these companies as their prices, in my experience, are higher than standard medical suppliers. The above approaches for obtaining medicines can also be used for obtaining medical equipment if you do have problems. The most important point is to be able to demonstrate an understanding of how to use what you are requesting.

Pre-packaged Kits: It is considerably cheaper to purchase your own supplies and put together your own kit. The commercial kits cost 2-3 times more than the same kit would cost to put together yourself and frequently contain items which are of limited value. The more you buy the cheaper things become – consider buying in bulk. Between Amazon, eBay and other online wholesalers it is possible to purchase all non-medication items (and most the non-prescription medications) for considerably less than in pre-assembled kits. It is also common for the "custom" commercial kits to contain items which are not required, or in such small quantities as to be useless.

There are kits available 'designed' (or marketed) by doctors aimed at the prepper market – most these fall into the same trap as above – they cost 2-3 times what it would cost you make the kits up yourself – let the buyer beware.

Storage and Rotation of Medications

Medications can be one of the more expensive items in your storage inventory, and there can be a reluctance to rotate them due to this cost issue, and due to difficulties in obtaining new stock.

Unfortunately, drugs do have limited shelf life. It is a requirement for medications sold in the US (and most other first world countries) to display an expiration date. It is our experience that these are usually very easy to follow, without the confusing codes sometimes found on food products, e.g. -- Exp. 12/00=Expires December 2000.

We cannot endorse using medications which have expired, but having said that, most medications are safe for at least 24-36 months following their expiration date. As with food the main problem with expired medicines is not that they become dangerous but that they lose potency over time and the manufacturer will no longer guarantee the dose/response effects of the drug. We discuss using expired medications also in Chapter 22.

Broadly, "toxicity" when talking about drugs generally, means an increase in adverse effects as opposed to the drug becoming poisonous, i.e. aspirin becomes toxic, but the toxicity is due to increased GI effects rather than lethality per se. Regarding toxicity in expired medication, we are referring to toxicity in the more common usage i.e. it becomes dangerous.

The important exception to this rule was always said to be the tetracycline group of antibiotics which could become toxic with time. However, it is thought that the toxicity with degrading tetracycline was due to citric acid, which was part of the tablet composition. Citric acid is no longer used in the production of tetracycline, therefore, the dangers of toxicity with degradation of tetracycline is no longer a problem.

Despite the above comments "Let the buyer beware." The expiry dates ARE there for a reason, it isn't simple a big-pharma conspiracy theory. There are almost certainly other medications, which do break down, and become toxic after their expiry date.

In addition, we recommend that if you are acquiring medications on a doctor's prescription that when you have the prescription filled you explain the medications are for storage (you don't need to say exactly what for), and request recently manufactured stock with distant expiration dates.

The ideal storage conditions for most medications are in a cool, dark, dry environment. These conditions will optimise the shelf life of the drugs. A small number of drugs require refrigeration to avoid loss of potency. These include insulin, ergometrine, oxytocin, and some muscle relaxants. Others, such as diazepam, rapidly lose potency if exposed to the light.

How Much?

This is a very individual question. It depends upon what you are preparing for and the number of people you will be looking after. It is impossible to say how much is enough. In order get a rough idea of what you should stock – think of your worst-case scenario and at least double or triple the amounts you calculate. Items which never go as far as you think they will include – gauze, tape, antibiotics, and sutures. If you have ever been hospitalised or had a close relative in hospital for even a relatively minor problem look at the billing account for medical supplies and drugs to get an idea how much can be consumed with even a relatively small problem. It is simple mathematics; drugs which you need to take more than once or twice a day disappear extremely fast – penicillin 4 times a day for 10 days on a couple of occasions quickly erodes your "large stock" of 100 tablets! The same number of ciprofloxacin required only twice a day last longer. Dosing frequency is worth considering when deciding amounts.

Lack of Supply and the Skill of Improvisation:

The key tenant of austere medicine is improvisation. A surprising amount of medical equipment and supplies can be improvised. This is also discussed at length in the Primitive Medicine chapter. The best reference regarding this is: "Improvised Medicine: Providing Care in Extreme Environments" by Ken Iserson'

Medical Kit Bags:

Before addressing what, you need, it's worth looking at what you're going to put it in. There is large selection of medical bags on the market – military and civilian styles, rigid and soft construction. They

vary in size from bum bags to large multi compartment backpacks and vary in price from less than $100 to more than $500 USD. We have selected 3-4 bags in each size range – personal use, first responder, and large multi-compartment bags. They cover a range of prices. What is right for you will depend on your individual requirements. If in a fixed location consider buying a rolling mechanics tool chest and using it as a "crash cart".

Personal Size:

- Battle pack (Chinook Medical gear)
- Modular Medical Pouch (Tactical Tailor)
- Compact individual medical pouch (S.O Tech)

First Responder Size:

- First response bag (Tactical Tailor)
- Modular bag system (Galls)
- Plano 747M Hard Case (Plano)
- NSW Medical Patrol bag (London Bridge Trading Company)
- Responder II (Conterra)
- Pelican waterproof case

Large Kit Bag:

- M5 style bag (Tactical tailor)
- MIII Medical pack (Eagle)
- NSW Training/Coverage Medical Backpack (London Bridge Trading Company) - one of the best large bags on the market. The STOMP II Medical Backpack from Blackhawk industries is very similar to the NSW training/coverage pack from LBTC – but significantly cheaper.
- ALS pack (Conterra)
- Kifaru back-packs (Kifaru) – not specifically medical, but can be customised inside and out.

When you have selected the bags that suit you, one approach to organising your medical supplies is:

***Personal bag/blow out kit**:* Carry this with you at all time. It contains basic first aid gear or in a tactical situation the equipment to deal with injuries from a gunshot wound or explosion. (figure 4.2) – this includes things to immediately render aid – it's almost like a pre-first aid, first aid kit!

A list might include:

Combat dressings / Israeli dressings
A haemostatic gauze compound – see comments below
Chest seals - Asherman chest seals stick poorly on wet, hairy chests despite being relatively common place. Hyfin or halo seals or even a rat glue trap works better. Studies have shown no advantage to vented dressings chest dressings vs. not vented.

Long IV cannula or specific pneumothorax decompression needle
Tourniquets x2
Oral and/or nasal airways.

First response bag: Carry this in your car; take it with you when you go camping, family trips to the river etc. It contains more advanced first aid gear and some medical items than a basic level medical kit.

Blowout bag: Personal medical equipment for a tactical situation (Dressings, HemCon bandages, Chest seals - , oral and nasal airways, iv cannula and a tourniquet).

Large kit bag: This is your home/retreat/bugging out medical kit. It contains your medical kit as opposed to simple first aid supplies.

Storage area**:** In your home/retreat. It contains duplicate and bulk supplies. Large plastic storage bins are ideal for this.

Pack/organise/store items that are fragile, easily damaged by water, or can become messy (most liquids and ointments, ESPECIALLY tincture of benzoin in any form) in individual zip-lock plastic bags. For high-value water sensitive items (pulse oximeters, blood glucose meters, etc.) consider packing in water proof hard cases – such as the Pelican or Otter boxes.

Consider packing items that are used together into “battle-packs”, ready to use packages – for example, pack an IV giving set with an IV start set with an Angio-Cath in a zip-lock bag – so you can grab one thing and be ready to go.

eBay is a good source of medical supplies and surgical instruments but be careful to know what you are buying: Make certain you know what you want and what it would have cost from a supplier.

A brief note about ‘follow-through’:

If you start something you need to be able to follow through on it. Do not embark on something when you can only deliver half the care a patient requires (especially if you have no prospect of delivering the other half).

For example - If you have a needle decompression in your blow out kit, you need a chest tube in your aid bag, you also likely need to provide a significant amount of prolonged field care (see Chapter 6) The decompression is a lifesaver in combat or in certain types of injury because of the rapid transport to a hospital that follows on. In the austere or survival situation that evacuation to hospital is rarely possible. Your kits need to encompass definitive treatment in austere settings. Otherwise don't bother stocking and training on the initial interventions only – it is a waste of time and resources which could have been spent on other important issues.

A brief note about airway management:

Before describing in detail packing lists for several possible kits we should discuss briefly airway management and the equipment associated with it. The details of this are best learnt in a First Aid/EMT class. The management of an airway has several steps:

- Basic airway manoeuvres – head tilt, chin lift, jaw thrust.
- Simple airway adjuvants – oral airways, nasal airways.
- Advanced airway adjuvants – laryngeal masks, Combi tubes.
- Endotracheal intubation – this is the gold standard of airway management. A plastic tube from the mouth into the trachea through which a patient can be ventilated.
- Opening a surgical airway

In addition, once you have managed the airway you need to ventilate the patient either with mouth-to-mouth/mask or using a mask - self inflating bag combination (e.g. Ambubag).

The reason for discussing this is that you need to decide how much airway equipment to stock. Our view is that there is relatively little need to stock anything more than simple airway devices such as oral or nasal airways unless you are planning (and have the skills) to give an anaesthetic for the simple reason that anyone one who requires advanced airway management is likely to be unsalvageable in an austere situation. If simple devices are not sufficient then the patient is likely to die regardless and introducing relatively complicated airway devices will not help. This, however, is an individual decision.

Basic airway equipment. From left – Surgical airway, Laryngoscope and blades, endotracheal tube, McGill forceps, self-inflating bag and mask, oral and nasal airways.

Specific Medical Kits

Everyone has an idea of what his or her perfect kit is and what he or she thinks is vital - so there is no perfect kit-packing list. What is perfect for one person's situation and knowledge may not be perfect for yours. You need to build a kit that you can understand and use. You also need to carefully consider your circumstances and type of group you have and the activities you will be undertaking when planning your medical kits. If your community plans to be self-sufficient farmers and ranchers who garden, cut firewood, make their own tools and butcher livestock - preparing for wound care and trauma will be more of priority.

In this section, we will look at two different approaches to setting up medical kits.

1. The increasing comprehensive layering approach
2. The specific purpose kit approach

1. Increasing Comprehensiveness

With an approach of increasing comprehensiveness of each kit, in this section we will look at a basic first aid kit, a more broad-spectrum basic medical kit, and an advanced medical kit able to cope with most medical problems. These are not the perfect kits or the ideal packing list – but they give you some idea of what we consider are needed to provide varying levels of care.

There is also frequent confusion over which surgical instruments to buy, how many of each, and what some do, so we have gone into more detail looking at some possible surgical kits, and what level of care can be delivered with each.

Note:

1) We've tried to use the international generic names for drugs. However, there are some differences between the British and the US pharmacopoeias and where possible we have tried to include both e.g. Lignocaine (UK & Oz/NZ) = Lidocaine (US)

2) We have not included any quantities. This is dependent on what you are planning for and what you can afford. Unfortunately, most medications require rotation with 1-5-year shelf lives, making this a costly exercise, as they are not like food you can rotate into the kitchen

3) Always store a supply of any medicines you take regularly. These do not feature on the packing-lists. However, it is vital to remember the blood pressure pills, thyroid hormones, allergy pills, contraceptive pills, asthma inhalers, or whatever you take regularly. Most doctors will issue additional prescriptions for regular medication to allow an extra supply at a holiday home or to leave a supply at work. The main problem likely to arise is covering the cost of the extra medication which may be expensive and not covered by insurance. If you have previously had severe allergic reactions consider having a supply of Epi-pens.

If you have a chronic medical problem such as asthma, you must ensure you have an adequate supply of your medication.

First Aid Kit

A comprehensive basic first aid kit is the building block of any medical preparations. With relatively simple equipment and supplies you can stop bleeding, splint a fracture, and provide basic patient assessment. Table 4.1 lists the suggested contents for a basic first aid kit. The following are the key components of any first aid kit - for work, sport, or a survival situation:

Dressings – Small gauze squares/large squares/Combined dressings/battle dressings/ non-adhesive dressings. There is a vast range. They serve two functions: - to cover and stop bleeding and to protect a wound. Exactly what you need is to a large degree personal preference – but whatever you buy you need small and large sizes, and they need to be absorbent.

Roller/Crepe Bandages – These go by various names (Crepe, Kerlix) – but we are talking about is some form of elasticised roller bandage. These are required to hold dressings in place, apply pressure to bleeding wounds, to help splint fractures, and to strap and support joint sprains. They come in a variety of sizes from 3 cm to 15 cm (1-4") and you should stock a variety of sizes

Triangular bandages – These are triangular shapes of material which can be used for making slings, and splinting fractures, and sprains.

Band-Aids – Lots of them and in multiple sizes. They are useful for protecting minor wounds and skin damage.

Oral or nasal airways – We have already discussed supplies for airway management. Oral or nasal airways are the basics for assisting with airway management. Often when combined with basic airway opening manoeuvres these are sufficient to maintain the airway of an unconscious person.

The face shields are recommended if you need to perform mouth-to-mouth on someone. The practical reality is the commercial face shields on the market do not work effectively

Sterile normal saline (salt water) or water – You don't need expensive antiseptic solutions for cleaning wounds. Sterile saline or water (and to be honest – even tap water is fine for most wound cleaning) is all that's required to irrigate or clean contaminated wounds. There is no clear evidence that using antiseptics over sterile water in traumatic (as opposed to surgical) cuts or abrasions reduces the incidence of infection. The best way to clean a wound is with copious amounts of water or saline. It is also useful for irrigating eyes which have been exposed to chemicals, dust, or other foreign bodies.

Tape – You can never have too much tape. It has 100s of uses. We recommend a strong sticky tape like Sleek™ or Elastoplast™. There are many other paper or plastic based tapes around – the main criterion is that it always sticks when required.

Gloves – Needed for two reasons. First, you should assume that everyone you deal with has a blood borne disease. When you are dealing with family members in an austere situation this isn't so important. The second reason is to try and reduce infection from the bacteria you have on your hands when dealing with wounds. In the same way that using antiseptics over sterile water for irrigation of wounds has minimal impact on the incidence of infection – the same is true for sterile vs. non-sterile gloves. When managing traumatic wounds (again this isn't true for surgical incisions and operations) there appears to

be minimal difference in infection rates between wound management with sterile or non-sterile gloves. Exam gloves are not sterile, can be used on either hand, and are just casually sized (small, medium, large, etc.). They come in boxes of 50 or 100. Nitrile gloves are more than latex. Sterile gloves are packed individually and have specific sizes – 7.0, 7.5, 8.0, etc. Size is important – know your size.

That's it really, a very basic and limited range of supplies. As you can see this is considerably less than what is sold in many commercial first air kits but this is all that is required in a basic first aid kit. These supplies cover most first aid situations. They give you the ability to provide basic airway management, clean a wound, control bleeding, and splint, and immobilise fractures and sprains. It will also protect you from contamination with the gloves and face shield.

Basic Medical Kit

The basic medical kit is the next step you take from a basic first aid kit. The example here is designed for someone with a basic medical knowledge and a couple of good books. A lot of common problems can be managed with it; minor trauma (cuts and minor fractures), simple infections, and medical problems. Between this and the larger more comprehensive advanced kit there is a wide spectrum depending on knowledge or experience. Most begin with a first aid kit and expand as knowledge and finances allow.

A smaller medical kit for your bug-out bag could be made up from the above by adding some medications (such as acetaminophen, Benadryl, and some Loperimide) and some instruments to a small first aid kit.

The Basic Kit in More Detail:

Medical Supplies

1. Soap - ability to wash your hands is so vital this is number one. You can also wash a wound or a whole body to help clean it. Hygiene will prevent a vast number of diseases.

2. Band Aids (assorted sizes) - speak for themselves. Covering a minor wound is handy – there are huge psychological benefits in covering a wound and keeping it clean. Small sheets of Tegaderm (transparent / adhesive dressings) are useful as an alternative and provide a clear view of the wound.

3. Povidone solution (iodine solution) - you can clean and disinfect wounds and at a pinch, do the same for water. A big risk of infection is potentially fatal so you really need the ability to clean. You can do almost the same with clean water in terms of cleaning wounds but iodine just helps that little bit more

4. Medium sized gauze squares – wiping wounds, covering wounds, mopping blood or pus, combining with a roller bandage to form a dressing. You can pack rolls of Kerlix gauze and cut squares off as you require them and it reduces the need to carry individual squares.

5. Elasticated (cohesive) roller bandages - to bandage on dressings, to strap an ankle, to impregnate with crushed up gib-board to make a homemade plaster bandage to plaster a broken arm. Coban is a type of elasticated roller bandage – it is especially good for holding dressings in place.

6. Combat dressing – cover bigger wounds and apply pressure to help stop bleeding. A well-applied gauze pad and an elasticated roller bandage will do a similar job, but what purpose-designed combat dressing do is make the application easier.

7. Cotton-tips – handy for cleaning small wounds and removing foreign bodies from eyes.

8. Nasal airway – help maintain an airway in someone who is unconscious – very easy to insert and can be inserted even if the patient is clamping their jaw down.

9. LT-king or I-gel – easy insert devices offering a degree of airway protection in patients who are deeply unconscious.

10. Superglue – close small wounds, glue splinting and wires of teeth to splint dental fractures and loose teeth

11. Suture material – 2/0 is the most versatile size. Nylon is probably most useful for general work and external skin closure – although not absorbable and needs to be removed. Vicryl (synthetic absorbable) is also very useful and mid-size and can be used for most suturing you would need to do and while absorbable, it does have reasonable initial strength

12. Scissors/Needle holder/Dissecting forceps/several small clips – we are cheating by only counting as one item but they go together generally. You need all to suture properly but they do enable you, when combined with a scalpel blade, to do most minor surgery.

13. SAM splint - useful for so many different splints - splinting c-spine, splinting an arm or a leg. They can be used as a short-term device or potentially in the longer term if required.

14. 10ml syringes - can be used to give smaller volumes from 0.5 to 10mls safely and enable IM or IV administration of some of the drugs in our drug list. They can also be used to irrigate a wound

15. 22g needles - can be used for injections but also splinter and tick removal, also be used attached to the syringe above to create a high-pressure irrigation device.

16. Scalpel blade - you can cut things – trim skin, open abscesses, work out foreign bodies.

17. Unsterile gloves - for your protection and to provide a barrier (although not sterile) for the patients from the germs on your skin. There is good evidence of minimal difference in rates of infections between sterile gloves, clean non-sterile gloves and well washed hands.

18. Tape - something heavy duty, thick and sticky! Can be used to hold things down, to tape blisters or to strap a sprain. The sticky bit is important – most tapes fail due to lack of stickiness!

19. Nasogastric tubes + lubricants – This is a technical skill and relies on your knowledge to do it safely, but this is a very versatile piece of you kit. you can feed an unconscious patient, you can feed ORT

formula to a sick child. At a pinch can be used as a catheter in someone in urinary retention. Can also be used to control a bleeding nose with a little knowledge, and to administer fluids rectally.

20. Dent-temp filling paste, an emery board and a couple of spare tooth brushes - can replace a lost filling, file a broken tooth edge, and you also have the superglue to help stick everything back together. The extra tooth brushes are for any cases of gingivitis. Oil of clove is also useful for direct application to a sore tooth.

21. Quality head torch – for looking in cavities and wounds. Emergencies at night are common and good lighting is vital. Being able to focus the light beam helps. Consider adding a battery charger and solar panel to maintain this capability – it's vital. It must be water proof and rugged.

It will all fit in a small backpack or a couple of plastic kitchen storage click/clax boxes.

Prescription medications

Lignocaine 1% (Lidocaine)	(local anaesthetic)
Augmentin	(broad spectrum antibiotic)
Adrenaline auto injector (Epicene)	(USA = epinephrine)
Morphine Sulphate	(strong pain killer) if available
Co-trimoxazole	(antibiotic)
Ciprofloxacin	(antibiotic)

Over-the-counter medications

Acetaminophen (Tylenol)	(mild analgesic)
Diclophenac (Voltaren)	(mod analgesic/anti-inflammatory)
Oral Rehydration powder	
Loperamide (Imodium)	(antidiarrhoeal)
Benadryl &/or Claritin	(antihistamines, short + long acting)
Cotrimazole	(anti-fungal)
Gamma benzene hexachloride	(body lice and scabies treatment – usually a body wash or shampoo)
Contraceptive pills / condoms	

There are some things we specifically haven't mentioned in the basic kit – the problem with medical kits is they just expand to fill all available space and what we are trying to do here is to give you useful boundaries of what supplies to focus on. Please don't think we are saying these are not useful – just they fall outside the top 20 priorities.

So, extras that may be useful, but only after your kit in every other way is complete, include:

A. Tourniquets - I love my CAT - but it's very much a nice to have not a must-have and is most suitable for mangled or shot limbs, and in civilian practice you don't see many of those, and, despite the opinions of some, we personally don't think you will see many post-shtf either.

B. Hemostatic compounds - Quick Clot etc. - much the same as for tourniquets. 95% of wounds we deal with, direct pressure does the trick and for the 5% it doesn't they are likely dead in a austere environment.

C. IV giving sets and fluids. Oral rehydration powder/formula is featured in the drug list and for many patients you deal with dehydration or mild to moderate shock it is adequate. It takes knowledge and skills to use IV fluids safely and you can be resuscitated by the oral route with ORT.

D. Pulse-oximetry, blood pressure cuffs, thermometers and stethoscopes – all useful and worth having, but not vital they fall in the top 20. It is possible to assess someone adequately using only your hands and eyes and get a very good impression of their condition and vital signs. The gadgets help, but are not vital.

a comprehensive basic medical kit

Advanced Medical Kit

This is designed for someone with extensive medical training and would allow one to cope with 90% of common medical problems including some surgery, spinal and regional anaesthesia, and general anaesthesia with ketamine, treating most common infections and medical problems, and moderate trauma. This list may seem extreme, but is designed for a well-trained person in a worst-case scenario. Even though it is a long list, it all packs down. This sort of amount of equipment packs into two medium size nylon multi-compartment bags and a Plano rigid 747 box

2. The Specific Purpose Approach

This approach uses the building block approach. While the contents will be the same as described above for the most part, how they are packaged and what you have in your kit on any given day will be driven by the needs of the activity or mission. This approach is probably more suitable for more experienced providers – where packing everything they could possible need in any circumstance is just to overwhelming and not 'cost' effective.

Generally, you will develop a generic kit which broadly serves the following purposes:

A trauma blow out kit/first aid kit – set up for common every day emergencies.
A medical kit – focusing on the management of illness
A trauma kit – focusing on the management of injuries and wounds.

Sitting behind these basic kits are more detailed kits which are focused:

Major surgery kit – which can be further divided down to abdominal, obstetric, orthopedic etc.
Dental kit
Laboratory kit – the ability to do more advanced testing like blood counts and x-matching
Anesthesia kit
Chemical/biological/radiation kit

Table 4.1 Basic First Aid Kit

Bandages and Dressings:
- Antiseptic Wipes
- Bandage (Crepe) – 50 mm (2")
- Bandage (Crepe) – 75 mm (2.5")
- Bandage (Crepe) – 100 mm (4")
- Bandage (Gauze) – 75 mm (2.5")
- Bandage (Gauze) – 100 mm (4")
- Bandage Triangular
- Dressing (Combine) 90 mm x 100 m m
- Dressing (Combine) 200 mm x 200 mm
- Dressing (Non Adhesive) 75 mm x 50 mm
- Dressing (Non Adhesive) 75 mm x 100 mm
- Dressing Strip - Elastoplast 75 mm x 1 m
- Eye Pads
- Gauze Swabs (Pkt 2) – 100 mm x 100 mm
- Sticking plasters

Personal protection
- Disposable Gloves
- CPR Face Shield

Instruments
- Clothing Shears
- Tweezers - Fine Point
- Splinter Probes

Other
- Saline Solution 30 mL Tubes
- Steri-Strips – 3 mm
- Survival Sheet
- Tape – 25 mm

Table 4.2. Basic medical kit

Bandages and Dressings
- Combat Dressings
- Medium gauze dressings
- Roller Bandages elastic + cotton (2in/4in/6in)
- Bandaids -assorted sizes and shapes (i.e. finger tips)
- Sleek Tape 1 in. (waterproof, plastic/elasticised tape)
- Cotton buds (Q-tips, cotton tips)
- SAM splints

Personal protection / Antisepsis:
- Chlorhexidine (Hibiclens) or Povidone-iodine (Disinfectant)
- Antibacterial Soap
- Non-sterile Gloves

Medications:

Lignocaine 1% (Lidocaine)	(local anaesthetic)
Augmentin	(broad spectrum antibiotic)
Acetaminophen (Tylenol)	(mild analgesic)
Diclophenac (Voltaren)	(mod analgesic/antiinflammatory)
Oral Rehydration powder	
Loperamide (Imodium)	(antidiarrhoeal)
Benadryl &/or Claritin	(antihistamines, short + long acting)
Adrenaline auto injector (Epicene)	(USA = epinephrine)
Morphine Sulphate	(strong pain killer) if available
Gamma Benzene Hexachloride	(lice/scabies treatment)
Co-timoxazole	(antifungal)
Contraceptive pills/Condoms	

Instruments:

Surgical scissors)	
Needle holder)	Enough to do basic minor
Sm curved clamps)	surgery - suturing, draining
Tissue forceps)	abscesses, cleaning a wound,
Scalpel blades)	etc.

Other:
- Nasal airways + LMA or LT-King airway
- Nylon or Vicryl 2-0 suture material
  (Your choice of suture material is up to you – and is covered in detail elsewhere in this book)
- 10 mL syringes
- 22 gauge needles
- Nasogastric tubes and lubricants
- Quality head torch

Dental:
- Oil of clove (tooth ache)
- Temporary cavity material

Table 4.3. The Deluxe Medical Kit

Bandages and dressings

Large gauze dressings
Small gauze squares
Combat dressings
Petroleum gauze squares
Plastic bags
Bandaids - assorted sizes and shapes
Elastoplast dressing
Steri-Strips - assorted sizes
Tincture of Benzoin
Roller (elasticised + cotton) bandages (2in/4in/6in)
Triangular bandages
Safety pins
Cotton buds
Paper tape (1/2 in/1in)
Sleek tape (1/2in/1in)
Plaster of Paris (or fibreglass) roller bandages (4in/6in)
Eye patches
Tourniquet

Airway

Oropharyngeal airways
Nasal airways (nasal trumpet)
Resuscitation facemask with one-way valve
Self-inflating resuscitation bag
Endotracheal tube/ Laryngoscope

Assessment

BP cuff
Stethoscope
Otoscope
Small Torch (flash light)
Thermometer (rectal for children)
Multi-dip. urine test strips
Pregnancy test kits
Fluorescein eye strips (+ some liquid tears to wet the strips)

Other

Small eye magnet (for FB's)
Space blanket
Air splints (arm/long-leg/short-leg)
SAM splints
Sterile and un-sterile latex gloves
Scrub Suits

IV Kit

Normal Saline or Hartmans
Haemaccel or Pentaspan (a colloid resuscitation fluid)
IV giving sets - maxi-sets + standard sets
Blood collection bags + filter giving sets
Syringes 2/5/10/20 mL
Needles 20/22/24 gauge
IV cannulas 16/20/24 gauge
Spinal needles 22 gauge
Leur locks/Heparin locks
Saline for flushes
Tourniquet
Alcohol Wipes

Dental Kit

Oil of cloves
Zinc Oxide paste
Dental mirror
Sharp probe
Compactor
Extraction forceps
Elevators

Surgical Kit

Mayo scissors
Dissecting forceps
Small + medium needle holders
Small curved clamps
Small straight clamps
Large curved clamps
Scalpel Handle + Blades (size 11, 12, 15) or disposable scalpels
Small Bone Saw
Lift- Out obstetric forceps
Emergency Obstetric Kit (includes cord clamps, bulb suction etc)
Suture Material Vicryl; 0, 2-0
Chromic 0, 2-0
Dermalon 0, 2-0
Surgical stapler and remover

Heimlich flutter valve
Chest drains – various sizes
Drainage bottles or Flutter valves
Penrose drains
Foley Urethral Catheters – 16 French (most useful size)
Urine Bags
Nasogastric (NG) tubes + spigots
Heavy duty scissors

Medications

Povidone - iodine Prep and/or		antiseptic skin prep
Alcohol prep		antiseptic skin prep
Chlorhexidine and cetrimide		antiseptic hand wash
Benalkium Chloride		Antirabies skin wash
Antibacterial Soap		
Paracetamol (Tylenol)	oral	mild analgesic
Aspirin	oral	wonder drug
Diclophenac	oral	mod analgesic (NASID)
Morphine	IV/IMSC	strong analgesic
Naroxone	IV	antagonist to morphine
Ketamine	IV/IM	IV anaesthetic
Diazepam	IV	hypnotic/sedative
Atropine	IV	pre-med/poison anti
Lignocaine (Lidocaine)	IV	local anaesthetic
Metoclopramide (Reglan)		anti-emetic
Augmentin	oral/IV	penicillin antibiotic
Metronidazole	oral	anaerobic antibiotic
Cefaclor	oral	cephalosporin antibiotic
Ceftriaxone	IV	cephalosporin antibiotic
Ciprofloxacin	oral	quinolone antibiotic
Mebendazole	oral	antiparasitic
Co-trimoxazole	top	antifungal
Adrenaline	IV/IM	(USA = Epinephrine)
Salbutamol inhaler		asthma/anaphylaxis
Rehydration formula		dehydration
Benadryl &/or Claritin	oral	antihistamine
OTC Cough suppressant		
Betnesol	oral	steroid
Hydrocortisone	IV/cream	steroid
Loperamide	oral	antidiarrheal
Ergometrine &/or Oxytocin	IV/IM	ecbolic for PPH
Neomycin eye drops		
Prilocaine eye drops		local anaesthetic
Starr Otic Drops		antibiotic ear drops
Mupirocin (Bactroban)	top	topical antibacterial cream
Gamma Benzene Hexachloride		topical for scabies and lice

Water for injection/normal saline for injection

Oral Contraceptive Pills
Condoms/Cervical Caps/Diaphragms

Chapter 5: Clinical Assessment

To accurately identify what the problem is, you need to find out enough about the patient and what has happened to them to do so. The process of gathering this information is known as clinical assessment or clinical examination.

Classically the clinical assessment consists of 4 parts – history taking, clinical examination, appropriate investigations, and the formulation/differential diagnosis. In this chapter, we will discuss each component in turn.

Exactly how to do every aspect of a clinical assessment is beyond this book. Our goal here is to point you in the right direction and give focus to what can be an overwhelming area of knowledge. There are several good references we recommend:

"Macleod's Clinical Examination", edited by Graham Douglas, Published by Elsevier
"Clinical Examination", by Nicolas Talley and Simon O'Conner, Published by Elsevier

A. History

The history will tell you the diagnosis – you just have to listen to what the patient is saying (well it does most of the time!). We often focus on examining the patient and expend a huge amount energy and anxiety doing this but by listening carefully to the history the patient will 9 times out of 10 tell you what is wrong with the patient. You skip or abbreviate the history at your peril.

Always ask the patient to tell you what's wrong/what's happened/what has been injured, they will frequently give you the diagnosis straight away – all you need to do is listen closely to what they actually say. In terms of importance in the clinical assessment, the ability to take a good history is one of the most important skills to develop.

Ask open-ended questions and allow the patient time to talk. The questions usually sound something like "tell me about…" or "explain what you mean by…". This type of questioning helps the patient think about their problem and how to explain it to you. They will often give you bits of information during this time that will help in your diagnosis.

A closed question results in a yes or no answer and does not give any additional information—for instance, "Do you vomit every time you eat?" and the patient says yes. If you said "I'm sorry to hear that you've been vomiting lately. Can you tell me about it?", the patient can start from the beginning and tell you that they've been vomiting everything they eat or drink for the past 24 hours and recently it has contained blood. This is much more helpful and guides your questioning better.

Sample History Taking

There are several different approaches to taking a history and there is no right way. The pneumonic SAMPLE provides a nice way of remembering the key components of what is need for a good history, especially if you are new to taking a medical history.

"S" is for "Symptoms":

A symptom is a manifestation of disease—for instance, vomiting and diarrhea are symptoms of a gut infection but can also be a symptom of acute pancreatitis. What changes has the patient noticed that they are telling you about? Swelling, fever, rash, pain? Can they characterize or further describe the symptom? Is the diarrhea bloody or does it contain mucous? Is it watery or just soft?

You gain information about the patient's symptoms from your good history taking. Questions you might ask are: what is bothering the patient, or what has happened to them? What has changed to make them feel unwell? The list of symptoms can help guide you to come up with a list of possible causes for their problem.

A symptom is something the patient complains of – information you gather from taking a history. A sign is something you examine.

"A" is for "Allergies"

We are primarily interested in medication allergies here – so they can be avoided if they need treatment. It is also worth knowing about allergies to bee stings or foods from an avoidance perspective.

What happens if patient is "allergic" and you have only a limited range of medication and the patient needs the medication and there is no alternative e.g. Amoxycillin only option for severe infection? Do you give it anyway?

The main question to ask here is what do they mean by allergy? Was it a near death experience or just a mild rash. Rashes are very common with lots of medications (morphine, penicillin, cephalosporins) and do not mean the patient has a life-threatening allergy. If the reaction was a rash only consider giving medication if could be lifesavingthis time – and be prepared for a more allergic severe reaction. Potentially expose them to a small amount of the medication first or make a small scratch in their skin and rub in a few granules of the medication – a DIY skin test – and see if there is a reaction. If the reaction they describe was life threatening anaphylaxis then administering it is not really an option even if it is potentially lifesaving and the only option.

"M" is for "Medications"

What pills are they taking? (Or did they take?) and what did they take them for. This knowledge is a lead into why they are / were taking them?

"P" is for "Past Medical History"

Asking about the patients past medical history gives you the information you need to interpret presenting symptoms properly. Has it happened before? Do they have a problem which predisposes to something else? Have they been deteriorating slowly or is this something sudden?

Ask about their general health problems – are they fit and active usually? Are they chronically unwell?

If the patient is a female between 12 and 60, ask about her menstrual and pregnancy history. When was her last period? Is her cycle regular? Where is she in her cycle? If she has been pregnant before have those pregnancies gone ok? While intimate and sometimes a little embarrassing for both doctor and patient, it is important for 2 reasons: Is the problem related to the menstrual cycle? Such as period pain, vaginal bleeding or ovulation pain. If she is or could be pregnant, could the problem be related to this? An ectopic pregnancy or a miscarriage

"L" is for "Last Ate"

It's not overly important in our austere or survival context. Traditionally its related to how "starved" the patient is for surgery – giving an anaesthetic on a full stomach is significantly riskier than giving one on someone who is starved.

"E" is for "Events"

There is overlap where with defining (s)symptoms which we have discussed above. It a reminder to further define what is going on. We have determined what the patient has complained about – this is an opportunity to further define those. What happened? What is the patient complaining of? What is the reason they are coming to see you? (We call this the "presenting complaint".). Let the patient describe in their own words what has happened or what is going on. Ask supplementary questions to further quantify the problem.

What does the patient think is happening or going on? "The presenting complaint"
When did it start? Where did it start? Where does it hurt? A description of the pain. Who was involved? Other patients? Possible infectious disease?

Supplementary Questions

We use these to further quantify the problem. Sometimes patients will not volunteer all the relevant information. Knowing what to ask is practice and experience – unfortunately! Here are some specific examples:

e.g. A complaint of diarrhea:
What do they mean by diarrhoea – are yours and their definitions the same?

Is there blood in the diarrhoea? Is it watery or thick?
Is there any associated abdominal pain? What came first?
Any associated nausea or vomiting?
Any associated fevers, chills, rigors?
Is anyone else sick? – you are looking for trends, suggestions of infectious disease?

e.g. Complaint of chest pain:
Where is the pain, what does it feel like, does it go anywhere?
Is it worse with movement or breathing?
Is it associated with anything?
Are they short of breath?
Do they have a fever?
Have they had it before? What happened?

e.g. Complaint of leg pain after a fall
Where is the pain?
How severe is the pain?
Can they walk? Is it a normal walk?
Does the leg "feel" normal?

Pain

One of the most common complaints is that of pain – that pain may be caused by many things, as a part of many different diseases or injury processes. The same questions can be asked for all painful conditions and the pneumonic PQRST helps:

P – What provokes/relieves/prevent the pain?
Q – What is the quality of the pain (sharp/dull/stabbing)
R – Radiation (does it go anywhere?)
S – Severity (how severe *or* disabling is the pain?)
T – Timing (when does it come/how frequently)

To further understand the severity of their pain, it is often useful to use a pain score. Ask them to describe how severe the pain is to them, on a scale from 1 to 10, where 1 is mild pain and 10 is extreme pain. Each person has a different tolerance for pain, so using a scale can help you understand their perception of the pain. It is also useful for a recheck, to determine if their pain level has changed any.

B. Examination

Anatomy and Physiology

It is hard to conduct an examination without at least a working knowledge of anatomy and physiology. If your going to understand potential causes of someone's abdominal pain or chest pain, you need to have an understanding of what sits where in the body and if it could potentially account for the pain. One of the most important foundations of medical knowledge is knowing how the body is put together and where different structures are and what blood vessels and nerves supply them. You need to invest some time into developing this knowledge. An accurate diagnosis will often stem from a clear understanding of anatomy and relating it to the patients complaints.

Sick or Not Sick?

This is probably one of the most fundamental questions – it dictates urgency and priorities your decision making. A very sick person demands immediate attention, while one that is feeling okay can wait.

You should ask this single simple question about every patient you are asked to assess or review.
How do you decide?

Spectrum of severity

Very Sick ----------Very well

Easy ***HARD*** Easy

Identifying the middle group is probably the hardest. Intuitively we can generally look at someone and know if they are either well or very unwell – but the group in the middle is much harder to identify.

Very rapid initial impression - "the 60 second assessment":

This provides a structured, yet quick way to try and identify at which end of the spectrum of the spectrum the patient is at or is leaning towards. You are using your senses to consider how sick the patient is.

Look: What is your initial "Impression". What position are they in, how are they sitting. "Tripod" – straight upright, leaning forward on their arms (this positions helps some people breath better). Look at the skin Colour - Pallor/Cyanosis/flushed/sweating. Work of breathing: does it look like their breathing is laboured? Is it hard for them to breathe?

Listen: Is their noisy breathing? Can you hear other breathing noises? Is there wheeze or stridor?

Feel: Introduce yourself and take hold of the patients hand.
What is the temperature - hot or cold?
Are the hands shaky or weak?
If possible expose the patient (undress to the point you can see how hard they are breathing and the colour of their skin – examining a patient in a couple of sweaters can be a challenge), it makes this initial assessment much easier.

Once you have performed the quick initial assessment, you can determine which category the patient falls into:

Not sick: The patient looks well, they are wide awake and orientated. They are warm, well perfused and have no respiratory distress. This enables you to adopt a relatively leisurely approach: Take the history, undertake a focused examination, formulate a differential and decide on a treatment plan. If you have other patients that are sick, you may ask the not sick patient to wait a bit or come back later.

Sick: The situation becomes time pressured the sicker the patient is. The first priority is resuscitation if they are unconscious or look very unwell. Under take a primary survey and obtain a set of vital signs. You treat as you go and try and get some history simultaneously. You can then undertake a more detailed examination and comprehensive treatment once more stable.

Primary Survey

The primary survey is a universal ingredient of first aid and EMT courses and for patients at the "sick" end of the spectrum it provides the next step in your examination following your quick initial impression. It is well covered in most first aid textbooks and courses and we only summarize it here – more detail on this and the resuscitative aspects of the primary survey see chapter 6 Emergency Care in Austere environments.

The acronym here is **C, A,B,C,D….**

(C) Control of massive haemorrhage: Traditional teaching has been Airway is the first step of the primary survey? However what good is a perfect airway, if you bleed to death over the couple of minutes you are focusing on the airway? So recently we have shifted to teaching – CABCD – control of massive haemorrhage.

(**A) Airway**: Compromised or not? Unable to talk/ hoarse voice/ noisy breathing – stridor/ tracheal tug?

(B) Breathing: Ask yourself three questions:

What is the work of breathing? How hard are they working to breath? What is the respiratory rate, how much recession (where the skin between each rib seems to pull in between the ribs with each breath), is there, are there any added sounds or accessory muscle use (the accessory muscles are the muscles of the neck, not normally used in resting breathing)?

What is the effectiveness of their breathing? Is there good air movement? Can you hear air moving in and out? What is the degree of chest expansion. If you have it this is where pulse-oximetry is useful (which is discussed in more detail later in the chapter).

What are the effects on other systems? Look at the heart rate – fast or slow? Early hypoxia = tachycardia. Late hypoxia = bradycardia. What is the skin color? Cyanosis is a deep congested blue color seen in tongue and around the lips when the levels of oxygen in the blood is low. What is the mental status, are they awake and alert or disorientated and confused?

(C) Cardiovascular: Ask yourself the same questions?

What is the work of the circulatory system? What effort is the heart having to make to pump the blood? What is the heart rate? What is the strength of the pulse.

How effective is the work of the heart? What is the pulse volume? What is the central (on the forehead or sternum) capillary refill time (discussed below)? What is the blood pressure?

What are the effects on other systems?
Respiratory – increased rate and tidal volume of breathing?
Skin – what does the skin feel like, what colour is the skin?
Brain – how is their brain working? Is there a change in conscious state? Are they confused?
Kidneys – reduced urine output

(D) Neurological
How awke and alert are they? There are several scoring systems to assess conscious level. For our purposes the AVPU scoring system is probably the most useful. It provides a frame of reference to monitor changes over time.

Alert
Responds to voice
Responds to pain
Unresponsive

Fortunately, most patients that you interact with in a health care setting are not at the stage of needing a primary survey and resuscitation. Most are well to moderately unwell and you need to take the time to gather your information and take a good history first. The first items of information to obtain are what are referred to as "vital signs".

Vital Signs

It sounds glib but vital signs are vital. A good set of vital signs combined with a good history will often give you all the information that you need to start making decisions about diagnosis or severity of illness.

There are 5 vital signs: heart rate, blood pressure, respiratory rate, temperature and pulse-oxyimetry.

Heart Rate

The heart rate you feel at the wrist or the carotids is the pressure wave from the contraction of the heart. It is represented by the formula: CO = Stroke volume x Heart rate (HR). HR is the prime determinant of how much blood is pumped. Stroke volume is the actual amount of blood the heart pumps with each beat and we have no easy way to measure it. So, we focus on measuring the HR which is how many times the heart beats per minute. It is not just illness or injury which influences heart rate. There are differing heart rates of dependent on ages (children have a faster HR than an adult). A patient who is fit and active has a slower HR than someone with a sedentary lifestyle.

There are several features to consider:

Rate. Fast or slow. <50 or > 90-100 is abnormal in adults (you need to check what an age appropriate rate is in children – generally the younger the faster is acceptable.)
Volume. Full or weak.

Blood Pressure

When we are talking about measuring BP what are we really taking about? There are two primary reasons to measure a BP – one is looking for the evidence of hypertension (or high blood pressure) – with this condition there is chronic damage to the blood vessels from high pressure and the risk of strokes and heart disease increases in the long-term (years). The second is for the assessment of perfusion, (hypotension) which is primarily what we discuss here.

What is perfusion?

One of the main purposes of a red blood cell is to carry oxygen to tissues and organs for use there. Many physiological processes in the body require oxygen to happen. Perfusion describes how much blood, and thus oxygen, the organs and tissues are getting. We are primarily concerned about organs such as the brain, kidneys and skin. They are very sensitive to low blood oxygen levels.

How do we measure perfusion?

Historically we have relied on BP, but we suggest not getting to fixated on measuring and assessing the BP. It is useful for trends and if it is very high or very low. The mid ranges are poor predictors of disease in isolation. A collective assessment of perfusion is more useful.

Generally, blood pressure below 100mmHg is a concern and suggests poor perfusion. High blood pressure (except very high – > 200/120) will only cause problems long term.

Capillary refill time (CRT) is also a useful assessment of perfusion. To assess this you need to push firmly with your thumb on the patient's sternum for 15-20 seconds and remove your thumb. The skin underneath will be a pale white where your thumb will have pushed all the blood out of the capillaries. The time it takes for blood to flood back into those capillaries is the CRT. Times of less than 2-3 seconds is normal, 3-5 seconds moderately delayed, > 5 seconds significantly delayed. A delayed CRT reflects poor perfusion.

Other measures of good perfusion are:

Strong radial pulse
Warm peripheries
Dry skin
Good colour
Conscious state – awake, orientated and appropriate
Good Urine production

Sometimes you may see signs of poor perfusion. The term "cyanosis" comes to mind—it describes a blue tint to the skin, mucous membranes and nail beds. The blood is not carrying adequate amounts of oxygen. If the mucous membranes are very pale the patient may be anaemic or have very low blood pressure, leading to poor perfusion.

Taking a blood pressure:

What are we doing when we take a BP?

Our objective is to measure how much pressure is in the blood veins, which helps us understand how well the heart is working and how well perfused the organs are. Arteries carry blood away from the heart and you think about them a little like a garden hose. If the water is running and there are no kinks in the hose, you don't hear any noise from the water moving through the hose. Once you step on or kink the hose, though, it is easy to hear the water rushing against the obstruction. We use this principle to measure blood pressure in the body.

- Smooth or laminar flow of blood in a blood vessel makes no noise.
- Turbulent flow in a blood vessel does make noise.
- Normal blood vessels have laminar flow and nothing is heard. When compressed or partially obstructed turbulent flow occurs.
- We compress an artery (with a BP cuff), until flow stops – until nothing can be heard and no pulse felt below the blood pressure cuff.
- We then slowly release the compression, measuring the pressure at which the flow starts and is turbulent – so you can hear it (systolic pressure).
- Then when the flow becomes "laminar" and you cannot hear it any more (diastolic pressure)

Equipment needed:
Blood pressure cuff + manometer
Stethoscope

Process:
Patient needs to be seated comfortably
Apply cuff just above elbow
Inflate cuff until radial pulse disappears
Listen over brachial artery and slowly lower pressure
First sound = Systolic pressure

Sound stops = Diastolic pressure

You can also just measure the systolic pressure by feeling for the return of the radial pulse as flow returns if you don't have access to a stethoscope. Blow up the BP cuff until well over the point the radial pulse disappears. Slowly lower the pressure in the cuff. The point at which you feel the pulse = Systolic pressure

It is important to understand the basic physiology behind a heartbeat. The heart contracts, sending freshly oxygenated blood through the body. This contraction is called "systole", and the first sound when taking a BP is the strongest because the heart is actively pumping. We call this "systolic blood pressure"- the amount of pressure the heart generates when at working at its strongest."Diastole" is the brief period between beats when the heart is resting, thus "diastolic blood pressure".

Respiratory Rate

This is the vital sign with most inter-observer variability – ask 10 people to measure someone's respiratory rate and you may well get 10 slightly different answers. If the patient knows you are counting their respiratory rate they will often subconsciously speed up. Count respiratory rate while appearing to take pulse.

Adults	12-20 breaths per minute
Children	start off faster and it slows with age.

Temperature

There are several ways to measure temperature – off the skin, the tympanic membrane, in the mouth and rectally. The oral or rectal routes are the most accurate (with digital or Hg thermometer). Tympanic is least accurate. Although accuracy is important, sometimes what we really want to do is to see the trend – is it going up or down? The normal range is 36.0 – 37.5°C. (96.8 to 99.5°F) Different books quote different cut-offs to define what is a fever. We have tried to stick with the majority – a temperature is > 38.0°C (100.4°F) with an oral or rectal measurement. Traditionally temperatures used to be taken under an armpit, however this has been shown to be unreliable.

There is a correlation (but it's not perfect) between the severity of the fever and the likelihood of a serious bacterial infection. Temperatures of > 39.5°C (103.1°F) are more suggestive of serious infection than lower temperatures.

Pulse Oxyimetry.

Pulse oximetry is the measurement of the amount of oxygen in the blood. It requires a pulse oxyimeter probe to measure – a small electronic device. It provides you with information about the effectiveness of the gas exchange process in the lung.

The normal range in a healthy person is 95-100%. For the majority of patients a saturation of less than 94% is an indication of the need for oxygen therapy. Saturations less than 90% suggests that there is very significant respiratory disease.

You can purchase reasonable finger-tip pulse oximeters for under $100 US– Nonin is a reliable brand. Beware of the very cheap ones originating from China. While not bad, they are more likely to break down and often are consistently more inaccurate.

Vital Signs in Children.

There are age specific values for HR, BP and RR. In order to interpret what is abnormal for a child you need to know what value their vital signs should be.

Heart Rate:	Newborn	120-180
	1-2 years	90-120
	3-10 years	80-100
	> 10 years	<80
Resp. Rate:	Newborn	40-50
	1-2 years	25-30
	3-10 years	20-30
	> 10 years	< 20

BP: can be harder to measure in smaller children than in adults and sometimes the other assessments of perfusion may be more appropriate.

Newborn	60-80 systolic
1-2 years	90-105 systolic
3-10 years	100-110 systolic
> 10 years	100-120 systolic

Interpreting Vital Signs

To interpret vital signs, you need to know what is likely to be normal for the patient. This varies with age (as described above), sex, fitness, and the presence or absence of chronic health problems – therefore taking a good history is important to help interpret the vital signs.

Often a single abnormal vital sign points you to the diagnosis – such as a substantially decreased temperature in a patient with hypothermia. However generally you look for patterns and the vital signs are part of the pattern – a patient complaining of a cough, who has a fast-respiratory rate and a fever is likely to have a chest infection.

A very blunt rule would be that the more vital signs are abnormal, the more likely the patient is to be unwell and the more grossly abnormal the more likely they are to be very unwell.

SIRS Criteria

We have already discussed the initial recognition of the seriously ill or injured patient. The systemic inflammatory response syndrome (SIRS) criteria provide a further tool for the early identification of those that are seriously ill. The presence of 3 or more SIRS criteria is a marker of serious illness. Usually it is due to infection but can occur if the patient has suffered from major trauma or has a condition like pancreatitis.

SIRS Criteria**:**

- Temperature $\leq$ 36°C or $\geq$ 38°C ($\leq$96.8°F or $\geq$100.4°F)
- Heart Rate $\geq$ 90 bpm
- Respiratory Rate $\geq$ 20 breaths/min
- Systolic BP < 90 mmHg – a systolic BP < 90 is universally bad. However, slim fit young woman are the notable exception who often have low BP in good health.

In sepsis, there is also an additional screening tool – the qSOFA score. More than 2 features combined with the presence of an infection suggests the patient is seriously ill.

- Hypotension: Systolic blood pressure less than or equal to 100 mmHg
- Altered mental status (any Glasgow coma score less than 15 or an AVPU assessment where the patient is only responding to voice or pain)
- Tachypnea: RR greater than or equal to 22

Early Warning Scores

A similar approach to recognizing the seriously unwell patient to using SIRs is the use of an early warning score. This is a numerical value based on the patient's vital signs which gives you an indication of the seriousness of the patient's condition.

Reproduced here is the UK's National Early Warning score – but several other exist.

First you take the patients vital signs and then calculate a score. It hasn't been validated in austere situations using lay medics – but it provides useful information to inform decision making

0-4	Unlikely to be significantly ill currently
5-7 or a single vital sign > 3	Potentially quite unwell – watch carefully, thoroughly assess and optimizing A,B,Cs and consider other treatment if required.
>7	Seriously ill. Needs resuscitation and aggressive care. Very close observations required to ensure patient is not getting worse.

The trend is useful – going up or coming down – getting worse or getting better. It isn't useful in isolation, but is a useful tool in combination with other aspects of your assessment.

NHS Early Warning Score (NEWS)

PHYSIOLOGICAL PARAMETERS	3	2	1	0	1	2	3
Pulse	≤40		41 - 50	51 - 90	91 - 110	111 - 130	≥131
Temperature	≤35.0		35.1 - 36.0	36.1 - 38.0	38.1 - 39.0	≥39.1	
Systolic BP	≤90	91 - 100	91 - 110	111 - 219			≥220
Respiration Rate	≤8		9 - 11	12 - 20		21 - 24	≥25
Consciousness Level				A			V, P, or U
Oxygen Saturations	≤91	92 - 93	94 - 95	≥96			
Any Supplemental Oxygen		Yes		No			

Learning to Do a Clinical Examination

In an ideal world (and how it is traditionally taught at medical school) you practice on normal people to get the technique right and learn what normal looks like. Then patients with specific clinical signs are introduced for you to practice on to learn to recognise the abnormal.

Because you have examined 100's of normal healthy people it is now easier to recognise the abnormal. Finally you begin to examine new patients where the signs are uncertain to see what you can elicit and compare that with a senior who also examined the patient. And this has been the way clinical examination has been taught for thousands of years.

If you don't regularly work in health care, the best you can hope for is have examined lots of normal people – friends, partners, SO's, kids – so that you will recognise when something is abnormal. Take every opportunity you can get to try and figure out what is normal. By doing this, hopefully the abnormal will stand out. Also, if you come across any of the above friends and families with a disease then examine them too – what does the chest of an asthmatic sound like? What does cellultis look and feel like? The more you examine, both normal and abnormal the better. The ability to diagnose a problem is based on a good history and the ability to identify when something is abnormal.

KNOW NORMAL!

What's a "Kappa Value"?

The kappa value tells you how reproducible something is if multiple people do the same task or assessment. Something with a low kappa value means that if 10 people examine the same part of the body they will be less likely to find the same thing or be consistent in their physical findings. Something with a high kappa value means that if 10 people examine the same part of the body they are very likely to find the same thing and get consistent results. This is also known as a specific aspect of the examination having a high or low inter-rater reliability. Every aspect of the clinical examination has a specific kappa value – eliciting pain in the abdomen may be high while listening for cardiac murmurs has a very low value. This is a useful concept to understand when thinking about clinical examination and value of different components.

Specific Body Systems

The history will generally guide you to what system (s) you need to examine. When you are starting out, it pays to follow a system from top to bottom or more specifically, start at the hand, work up the arm, examine the head and neck, chest, abdomen and then lower limbs – examine everything – this gives you a better opportunity to detect an abnormality if it is there. Then once you have more experience you can target your examination to a specific system or anatomical region.

Remember that you will not automatically know what a clinical abnormality means. Part of the process is to identify the abnormalities and document them as you find them. Figuring out what it all means is the next step once you have elicited the findings.

1. EENT Examination (Eyes/Ears/Nose/Throat):

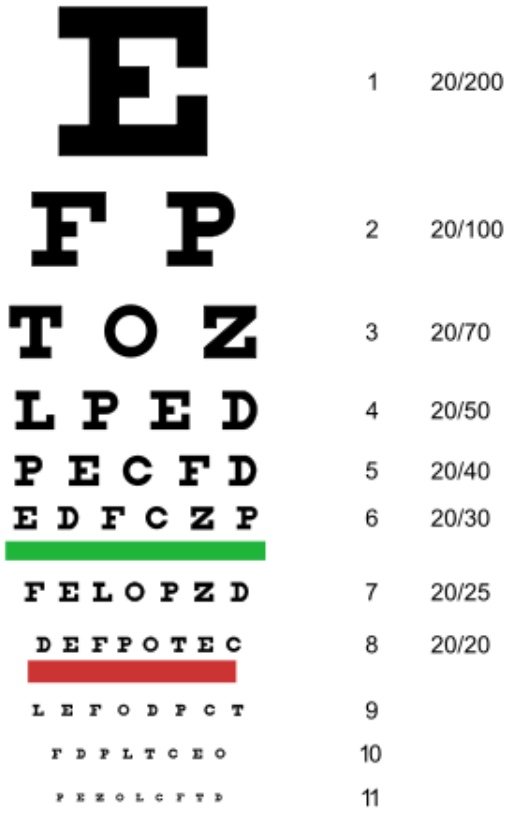
Eyes

The first and most important question is are they working?

Can the patient see clearly?

Formally test vision – each eye at a time, classically we use a Snellen chart – these are the eye charts you are probably use to using seeing at the doctors – detailed instructions for using a snellen chart are covered in the references. An acceptable alternative for the patient read standard US trade paperback text at 30cms (12 inches) from each eye. If they can, then their visual acuity is close to normal.

Compare left eye to the right eye. If the patient normally wears glasses and they don't have them with them, you can correct for that by asking them to read the chart or text though a pin hole in a piece of card.



Snellen eye chart

What do the pupils look like?

Big or small? Estimate them in mm.

Are they symmetrical from Lt to Rt and are they round or a funny shape? Do they look more like a tear drop shape?

Do the pupils react?

Shine a flashlight into each eye in turn, looking to see if each pupil is getting smaller. When you shine the light into one eye does the other eye constrict (the consensual light reflex)?

What does the conjunctiva look like? Is it clear or is bloodshot and congested looking?

What does the front part of the eye look like? (the bit in the front – the anterior chamber)

Look for fluid or solid levels, blood or pus.

Stain the eye with fluorescence if it is available – fluorescence is an organic dye, which stains up starches and ulcers on the surface of the eye when a blue or black light is shone on the eye. It comes as thin strips of filter paper to gently dab against the eye and the tears cause the dye to run across the eye, or as drops you apply.

Look for foreign bodies.

Look in all the nooks and crannies, avert the eyelid and look underneath. You can try removing small foreign bodies with a moistened cotton bud and gently wiping the FB away.

Check for eye movements – can they look up/down/left/right?

Ears

It's very hard to test hearing in an austere environment – proper hearing assessments requires significant equipment you are very unlikely to have available to you. We are stuck undertaking a very gross assessment of hearing – whispering words 20 cm from the ear and assessing for accuracy

Palpate around ears feeling for tenderness. Examine the external ear canal looking for pain, swelling or trauma. To look beyond the entrance of the external the canal usually requires an otoscope, but it is possible to improvise by making a cardboard trumpet and using a head torch as a light source. You are specifically looking for wax, pus, swelling and foreign bodies

Look at the eardrum, inspecting it for perforations, redness, and fluid levels

Throat

Feel the front of the neck for any tender lumps suggesting enlarged lymph nodes. Ask the patient to open their mouth wide. Inspect the tongue and the back of mouth. Look for redness and enlarged tonsils – to spot an enlarged abnormal tonsil, you need to have seen lots of normal tonsils – so look at every normal pair you can.

2. Cardio/Respiratory Examination:

The approach we take when we are examining the chest is to – look/listen/feel.
Position the patient sitting-up at 45 degrees if possible, in a chair slightly reclined.

Look

Count the breathing rate. Is the patient refusing to lie back – trying to sit forward (that is often seen in patients with respiratory distress)? Look at the neck veins – are they distended? Are the muscles on the neck standing out and involved in breathing? (Accessory muscle use) Is the space between the ribs and at the top of the breastbone (sternum) being pulled in? (In-drawing)
Has the patient enough breath to speak? - Words only? Full sentences?

Does the patient look flushed or sweaty – consistent with a fever? Do the lips or tongue look blue? (Cyanosis – a late very bad sign in respiratory disease, reflecting not enough oxygen in the blood).

Look at the chest wall (front and back). Look for bruises or wounds. Look for symmetry of chest wall and chest wall movements (asymmetry may be broken ribs).

In trauma look for patches of inwards movement when the rest of the chest wall is moving out = Flail segment (associated with two or more fractures on same rib and ribs above and below).

Feel

Feel for the pulse at the radial artery at the wrist – measure the rate, regularity and volume.

In patients with poor perfusion and low blood pressure, peripheral pulses may be lost. The worse the perfusion the harder it is to feel pulses. They are generally lost in the order of radial, brachial, femoral and carotid as the state of perfusion worsens.

Feel for the temperature:

Feel the chest wall. Palpate it gently. It can be easier to feel for asymmetry than to see it.Feel for "crunching" or crackling under the skin. This can be associated with a pneumothorax (punctured lung) and is air in the tissues under the skin. Feel for any broken ribs – follow each one around from front to back – an area of exquisite tenderness following trauma is almost certainly a fractured rib.

Tap gently up and down each side of the chest front and back (back is the most important area). The normal resonant sound – makes a sound like tapping a hollow wall. A dull heavy sound generally is fluid or pus

Feel the trachea (windpipe) in the front of the neck – should be in the middle and not positioned to the side

Listen

Listen at the mouth first. A whistling exhalation noises = Wheeze. A high-pitched honking noise on breathing in = Stridor

Listen on the chest – front and back. A stethoscope is ideal, but you can use your ear or a rolled up newspaper. Start on the back listen all over both sides. Compare the left with the right

Can you hear air movement everywhere? Does it sound soft, quiet and normal? Listen to healthy volunteers so you gain an appreciation of what normal sounds like. Are there any high-pitched noises when the patient breaths out?

Wheeze – suggestive of asthma. Are there any wet sounding crackly noises?

Crackles - suggesting fluid on the lungs.
Localized (one spot) = probably infection
Generalized (all over) = probably heart failure (still could be infection)

Any areas with no breath sounds suggests a collapsed lung or a lung full of pus (pneumonia)
Any crunching noises (like walking on fresh snow) = a pleural rub – seen in infection or pulmonary embolism (clot on the lung) but can be very hard to recognise.

You can listen to the heart – realistically even cardiologists can often not even agree what they are listening to when they listen to the heart. The likelihood of enthusiastic amateurs to accurately listen to heart sounds and murmurs is low. It is certainly possible to 'take a pulse" by listening to the heart and its reasonable to do that – but the value of listening for specific sounds is low.

3. Abdominal Examination:

The same approach applies - look/listen/feel.

A good knowledge of anatomy is one of the most important parts of examining the abdomen – knowing where structures lie in the abdominal cavity.

The ideal position to examine the patient is to lie them flat on their back with their hands by their side – this serves to relax the muscles of the abdominal wall and make the examination easier.

Look

Look at the patient – sick or not sick? Look at the whites of their eyes – do they look yellow (= jaundice, generally a sign of liver disease or obstruction of the system draining the liver). Do they look in pain – are they rolling around with colicky pain (pain that comes and goes, and is often associated with a problem in a hollow organ – gall bladder, bowel, or ureters) or are they lying completely still with constant pain (suggestive of peritonitis – inflammation of the lining of the gut cavity).

Look at the abdomen – the front/back/sides – you're not finished until you have looked 360 degrees. Any bruises or wounds? Does it look bloated or distended? Look for scars – these can suggest previous surgeries. Have they already had their appendix out? (a scar in the RLQ right lower quadrant). Also, increased risk of bowel obstruction if previous surgery, whether recent or past.

Look for movement of the abdomen. Normally the abdomen moves with breathing - if the patient has peritonitis they will splint it and it will not move. Ask the patient to suck their tummy in and blow it out. Inability to do this can also suggest peritonitis

Feel

Feel the abdomen. Using the flat of your hand move around each of the four quadrants of the abdomen in turn – left upper quadrant, left lower quadrant, right upper quadrant, right lower quadrant – the location of the pain can help direct you to what organ is the problem.

Examine once around the abdomen to gently localize for pain and then do it again more firmly. Do not poke or jab – this causes the abdominal wall to tense up. You are feeling for tender areas, especially areas where the pain is worse when you take your hand away (rebound pain – this is associated with peritonitis) or it feels rigid (like a board) under your fingers (peritonitis also).

You are also feeling for any masses: RUQ = Liver, LUQ = Spleen, Loins = Kidneys, Supra-pubic = Bladder or Uterus

Tap gently over the whole abdomen. It should sound hollow. If very resonant, it may signify extra bowel gas = obstruction. If resonant around the umbilicus, but dull around the sides, this can suggest fluid = ascites

Feel the femoral pulse or any unuual central abdominal pulses. Feel the temperature.

Listen

Listen to the abdomen with a stethoscope.You can use several "normal" people as a comparison – the inside of the abdomen is normally a noisy place – as fluid and gas moves through the bowels it makes a lot of noise. Listen in each quadrant for "bowel sounds". No bowel sounds = peritonitis. Very loud musical sounds = bowel obstruction

Intimate Examinations

This is the examination of someone's genitals – penis, testicles and anus in males and vulva, vagina and anus in women. In contemporary practice generally a chaperone is present – someone of the same sex as the patient, to make them feel more comfortable with the experience. In an austere or survival situation we should try if possible to offer the patient the same experience – but this may not be possible or practical.

You need to clearly explain what you are doing and why.

Genitals. Looks for lumps and tender spots.

In men specifically, you need to gently palpate the external genitals. A rectal examination (gentle insertion of a finger into the rectum) can be useful looking for a tender prostate or painful areas of the lower bowel.

In woman, gently feel inside the vagina for tender spots and masses. Move the cervix around – discomfort is ok, but significant pain can be associated with inflammation in the pelvis. An examination of the breasts is also part of the intimate examination in woman – looking for tenderness, lumps or lack of symmetry. Feel for lymph nodes under the arms.

4. Neurological Examination:

A neurological examination can take 60 minutes or 60 seconds depending on your knowledge and experience. For our purposes, we will focus on the 60-second neurological exam. It is unreasonable to expect a more comprehensive exam and realistically you can get 95% of what you need from a brief focused assessment.

We are aiming to determine if there is:

- Any confusion
- Any weakness
- Any loss of sensation
- Any loss of coordination

The best way to do this is to do simple tests to determine if the body functionally works – can they walk, can they maintain their end of conversation and not appear confused, can they pick up a cup of coffee or can of Coke, can they walk steadily in straight line? For us functional assessments work better than testing a specific nerve or muscle.

Orientation

Name, Date of birth, Location, Time, Day of Week, Date and Year
Conscious state – are they awake and alert, or do they keep closing their eyes and drifting off to sleep?

Muscle Strength

Get the patient to doing something functional with each of the main muscle groups. You are looking specifically for symmetry from left to right and upper to lower limbs.

Hands – ask them to squeeze yours and feel for strength. Then ask them to pick up a small object with each hand. This tests power and also fine motor control and co-ordination.

Elbows – bending and straightening against resistance.

Shoulders – get them to shrug their shoulders against some resistance.

Hips–bending and straightening against resistance. Lifting the leg straight up of the bed.

Knees – bending and straightening against resistance.

Ankles – point the toes towards the roof and towards the floor.

Sensation

Ask patient to close their eyes and say yes when they are touched with a piece of cotton wool or a sharp stick. Work your way down the body – going from left to right. In terms of our assessment, we are just

looking for gross abnormalities – left vs. right, upper vs. lower. If you delve further into the recommended reading you will find reference to dermatomes – assessing these require significant knowledge, but if you can master these, it is possible to more accurately map which nerves and spinal levels are not working or are abnormal.

Balance and Coordination

Ask the patient to stand with legs a shoulder-width apart (be prepared to catch them).
Ask them to close their eyes and see how well they can balance.

Then ask them to stand on one leg at a time, each side.
Ask the patient to walk heel-toe for a short distance.

Hold your finger about 50cm from the patients face. Ask them to move their finger from their nose to your finger and back as fast as they can. Repeat with the other hand. You are looking to see how consistently accurate they can be with the finger-nose test.

The Face and Cranial Nerves

So far we have tested the peripheral nervous system (PNS) – the parts of the nervous system which arise from the spinal cord. When we move to the head and neck we start to examine the cranial nerves – those arising from the brain directly. Like assessing the PNS testing can take 60 seconds or 20 minutes – we are focusing on the abridged 60 seconds.

If you haven't already, examine the eyes.
Look at the size of the pupil, the black hole in the center. If you are in a lighted room or bright sunshine, the pupil should be small. Turn the lights out or cover their eyes for about 30 seconds, then quickly turn the lights on and check the pupils again. They should have gotten bigger with the low light levels, and will begin to constrict and become smaller now
Ask the patient to smile and screw-up or close their eyes tight up.
This should be symmetrical, note if one side droops more than the other.
Ask the patient to stick their tongue out. This should be in the midline.
Ask the patient to swallow a small glass of water.

General Points Around Neurological Exams

When you are examining a patient, compare the left side with the right side and upper limbs with the lower limbs. Determine if the abnormalities are generalised or symmetrical.

Weakness on one side > other = Hemiplegia
Weakness of lower limbs only = Paraplegia
Weakness of upper and lower limbs = Quadriplegia

5. Bone and Joint Examination:

It is the same basic process for every joint you examine – look/feel/move.

Look: Visually inspect the joint. Compare with the unaffected side. You are looking for:
- Swelling
- Deformity
- Lesions
- Colour changes

Feel: Gently place you hand on the problem joint. Feel for the temperature – hot or cold. Compare with the other side. Look for fluid in the joint – does it look swollen in comparison to the other side? Is there an effusion? (fluid in the joint). Does it hurt when you do this? Is it tender? Always return to the anatomy books to correlate tenderness with structures

Move: There are two components to this. Firstly, the range of movement in the joint. Does it bend and move the way you would expect? First, ask the patient to move the joint as best they can (passive), then move the joint yourself (active). Frequently you can elicit significantly more movement with active than with passive. Then assess of the stability of the joint (are the ligaments that are supposed to hold the joint together working and is the joint nice and stable when you rock it or does it feel loose, like it isn't quite firm enough?)

C. Investigations.

In Chapter 15, we discuss and introduce simple laboratory tests that may be available in an austere environment. However, one of the first assumptions we make when undertaking clinical assessment in an austere environment is that there will be no access to laboratory tests. If you do, then that's a bonus – but the starting point needs to be that you will not have access to any.

D. Formulation/Differential Diagnosis.

Once you have taken a history, examined the patient and undertaken any investigations available to you need to decide what you think is wrong with the patient. You potentially will have recorded a lot of information and not all of it will be useful. You may need to try and sort out what is relevant to the problem in front of you.

The broad process is: History + Examination + Investigations + Circumstances = Differential

What are circumstances? Is this environmental? Is this an infectious disease? Does diet have a role? Current events may aid the diagnosis. E.g.- nuclear meltdown in a city 25 miles away leading to radiation sickness, war zone leading to traumatic injury or PTSD, no shelter for days leading to sickness from exposure/hypothermia/hyperthermia.

Often a good history and a look at the patient and a set of vital signs will give you enough information to come up with a clear diagnosis and on other occasions this will require a through clinical examination.

List all the things you have discovered about the patient and then apply your knowledge – you may know enough to start making decision or you may need to take to the textbooks.

Based on your knowledge and reading think of all the possibilities which could explain the problem. Order the list from most to least likely – determine the balance of probabilities based on:

Your experience
The patients previous experience
The situation / environment you are in

What more information do you need to differentiate the possibilities on your list? Ask more questions. Examine some more. Do some simple tests if they are available.

Look up the most likely diagnoses. Read about each in more detail. Think – "do any explain the presentation?"

Finally make a plan!! Remember - patients don't present like textbooks. Think is it a reasonable diagnosis = right age/right sex/right geography? If you're not sure what is going, wait and then reassess – 6/12/24/48 hours later – depending on the problem.

E. What If You Don't Know Exactly What's Wrong?

So you have taken a history and examined the patient, then thought a bit about what's going on, but alas, you are no further ahead.

If that's the case you will need to adopt a general approach to treatment rather than a disease specific one (and even if you do have a specific treatment, it may still be appropriate to utilise these general treatments).

- Rest for several days – constantly reassess the patient over that time and the diagnosis may become clearer.
- Nurse the patient in a slightly darkened room at an appropriate temperature.
- Maintain hydration with fluid therapy.
- Treat pain
- If fevers are making the patient uncomfortable treat those.
- Maintain some energy going into the patient – small nutritious meals/plenty of iron/ multivitamins. Avoid fatty meals (especially if the presentation was related to abdominal pain). If available, provide plenty of fresh fruit. Hydration is clearly the priority if the patient is ill, but nutrition is a close second when the person is ill – the body needs nutrients to repair itself and to fight infection – so food is almost as important as fluid.

Chapter 6: Emergency Care in an Austere Environment

Part 1 – Initial Resuscitation

In an emergency, people can die from their injuries within minutes if rapid care is not provided. Some will die regardless. This requires those providing initial care in an austere medicine situation to be able to:

1) Recognize what is/is not a condition that requires immediate attention;

2) Have the knowledge to treat those conditions which will kill your patient in a matter of minutes, and

3) Have the required medical equipment readily accessible to provide immediate emergency care.

Outside of the survival situation, this field of medicine is the responsibility of emergency medical technicians, paramedics and emergency department staff. In the survival situation this is knowledge and skills that you need to know soundly without reference, as time is paramount. With only a few simple skills you can save the life of someone. Survival emergency care is not only made more complex by the lack of experienced providers. It can also be more complex due to the natural (heat, cold, rain, post-natural disaster etc.) or man-made (shootings, bombings, war zones or hostile areas) environments.

In this chapter, we outline the broad requirements for the provision of austere emergency care in a remote environment. This topic is well covered, in considerably more detail in most first aid textbooks and courses – what we are trying to do in this chapter is to focus that knowledge on the austere or survival situation.

A primary survey occurs simultaneously with the resuscitation process described here. The primary survey is also discussed in the Chapter 5 the Assessment chapter.

Evaluate the Scene:

When finding yourself presented with an emergency in a survival situation, the first thing you should do is stop and take a second to evaluate the scene. There are numerous instances where rescuers have, with good intentions, rushed to help the casualty only to become casualties themselves.

The scene is evaluated as follows:

1) STOP. Take control of yourself. Take a deep breath and actively look for things that might cause you harm or further injury the casualty. This could include indices such as fire, electrical current, water, poisonous gas, shooting, landmines, broken glass, etc. This may require you to walk around the scene to observe it from more than one angle.

2) Evaluate quickly how many casualties you have. Evaluate how many rescuers you have. If you have more than one rescuer as part of your team then take a second to decide who is "in charge" of the scene. That person then has the lead.

3) Decide if you can evaluate and treat the casualty in place given the hazards discovered or if a rapid move of the casualty to a safer location is warranted, given that doing so may make the casualty's condition worse. If you cannot move the casualty, is there anything you can do to make the scene safer?

4) Assign casualties to rescuers or, if you have more rescuers/bystanders then casualties, start concurrent activities such as fetching medical supplies and stretchers, building shelters if required, putting out fires, etc.

A useful tactical skill is evaluating a scene from a distance – what does the mechanism of injury look like? What can you see through binoculars? What can you assess - skin color, respiratory rate?

Triage:

The word 'Triage' is from the French word "to sort" – it has an interesting history dating back to the Napoleonic era. At its most basic form it is a process to ration health resources.
Examples include:

- Multiple casualties vs. limited health resources
  - Who do you treat first?
- There is a limited supply of a drug vs. several people need it
  - Who gets it?

Within civilian peace time ethical values, it is relatively clear - the greatest good to the greatest number. Resources can save 1 seriously ill person or 10 moderately ill people. The choice is generally clear → save the 10 moderately ill. These sorts of decisions made every day in medicine currently.

There is potentially an ethical conflict in austere practice. You have finite supplies and resources.
Do you pour all your resources into possibly saving your wife/child/best mate NOW, who has a 10% chance of survival with maximal therapy OR Do you save your resources and potentially save 10 other people who have a 90% chance of survival with minimal therapy in the future? There is no right answer here – the solution to an ethical conflict like this is a personal one.

Mass Casualty Triage:

This is how the concept of triage applies in an austere emergency.

The usual approach is that you are presented with a scene of multiple people requiring emergency care, you quickly prioritize those who need the most help first. We divide the wounded into 4 groups- dead, critical (may die soon), severe (major injury but not in danger of death soon) and minor (injured but alert and able to move on their own). We generally would focus on the critical first, then the severe, and then the minor.

Within a long-term survival situation, you will likely be limited in both staffing and supplies. In this case, you need to be even more pragmatic than the above triage process. Don't waste time on those that will die (within your environment and resource constraints) and focus on those that could survive with the care you can provide. The general principles in an austere situation:

- Not breathing = dead
- Massive truncal or head injuries = dead
- Everyone else = resuscitate

The Primary Survey:

The primary survey provides you a quick way to determine if someone has life threatening injuries. Here the primary survey will occur while performing resuscitation techniques as needed.

The survey follows the "C-A-B-C-D-E" approach.

C- Control of massive hemorrhage
A- Airway
B- Breathing
C- Circulation
D- Disability
E- Exposure

Control Hemorrhage

Direct pressure + wound packing

The concept of direct pressure is simple. Take a dressing and push directly over the area that is bleeding until the bleeding stops. The pressure applied needs to be greater than the pressure of the bleeding vessels – arterial or venous. Provided it is, the bleeding will stop. Achieving that pressure is generally easy to do, however getting it directly over the offending vessel can be difficult or, if there are multiple bleeding vessels, technically difficult.

Direct pressure is combined with focused wound packing. Small superficial wounds are relatively easy to apply direct pressure to. The problem arises with bigger and deeper wounds. Focused wound packing involves using ribbons or squares of gauze packed into the wound over the bleeding area and then pressure is applied onto the packed area. This combination is generally successful and most bleeding will stop with wound packing and direct pressure. That's a fundamental concept. Much is written around advanced techniques utilizing hemostatic gauze and tourniquets, but the truth is, outside of a major vessel injury or a massively destructive wound caused by an explosion (such as an IED or a mine), direct

pressure works well but is almost universally done poorly and focus seems to go the sexy, more advanced techniques.

The Israeli bandage was the prototype of many subsequent bandages. The main feature it contains is a 'clinch' over the gauze pad, which enables you to apply additional force over the center of the pad. Provided you center the pad over the bleeding area by clinching down the dressing, significant additional direct pressure can be applied to the wound.

Israeli bandage being applied showing how the clinch is used. First Care Medical

Normal gauze vs. Hemostatic gauze:
Hemostatic gauze is gauze impregnated with additional compounds which hasten the clotting process. There are several different varieties of hemostatic gauze (Combat-gauze / Cleox-gauze / Chito-gauze) available on the commercial market. They have been developed by the military to enhance hemorrhage control on the battlefield. There are several key points relating to hemostatic gauze. First, they do appear to enhance clotting when applied to a wound. Second, there is no evidence that hemostatic gauze is superior in any way to standard gauze. It is no worse. But it is no better. The issue with the studies is that they are conducted using staff that are very experienced and well trained at hemorrhage control. The bigger question with hemostatic compounds is do they work better in the hands of an amateur operator than normal gauze? If they do they are worth the money, but as of now that evidence is not there.

Indirect pressure and tourniquets:
Tourniquet's (TQN) work to stop the flow of blood before it gets to the wound. This is achieved by applying a constrictive band above the wound over where the artery comes down to supply the area with blood. Compression there reduces or stops the flow to the wound and helps facilitates clotting. There are a variety of different TQNs on the commercial market – one of the most ubiquitous is the combat application tourniquet (CAT) – in principle all a TQN requires a broad band to around the circumference of the limb and a windlass to tighten it – but it is important that the application of force around the limb is even.

The ideal location for the application of a tourniquet is where the pressure from the TQN will press the artery against underlying bone to compresses it. In the arms, pretty much any location will achieve this, however in the legs you need to be more conscious of where you apply the tourniquet – high to mid-thigh and below the knee are probably optimal, although anywhere can be used.

It is important to remember that the tourniquet will not only stop the flow of blood to the open wound but also to other body parts below it.

Tourniquets work best when applied over a single bone where the arteries and veins can be compressed down onto the bone.

First choice locations would be the distal end of the humerus (upper arm bone) or distal end of the femur (the thigh bone). Followed by the proximal end of those bones. Third choice would be over the tibia and fibula or the radius and ulna – the reason these locations are third choice is that it is harder to achieve the required pressure over two bones.

The tourniquet should be tightened to the point bleeding stops. An inadequately applied TQN may make bleeding worse, not better, by only stopping venous drainage and allowing arterial flow to continue.

When do I take off the tourniquet?

Within a first world EMS system once applied a tourniquet remains applied until the patient gets to the ED or Operating Room. However, if a tourniquet has been applied in an austere environment a different approach is required.

Once the limb has been tourniqueted, ensure that wound is well packed (if required) and has a wide firm pressure bandage applied. Now wait 30-60 minutes.

First, look at the wound and consider the mechanism of injury. Do you think it is likely the bleeding may have stopped by itself?

If you think bleeding may have stopped (based on the nature of the wound) simply take down the tourniquet and see what happens. Then subsequently manage the wound as appropriate. If heavy arterial bleeding restarts then reapply the tourniquet and proceed to step 2. If bleeding restarts but is not torrential attempt to control with direct pressure and wound management.

If you think bleeding is unlikely to have stopped then you need to prepare surgically to deal with the bleeding vessels and this may or may not fall within your competencies. If you lack the surgical ability (ligation or cautery) to deal with ongoing vessel bleeding it may prove fatal for the patient. Fortunately for the majority direct pressure +/- a period of TQN application will stop most bleeding.

Ideally a TQN should be applied for less than 60 minutes. If the situation requires it, application times of 3-4 hours are acceptable, but not longer. As soon as you apply a TQN you should be working on the removal and subsequent wound management plan. Mark the time the TQN is applied to keep track of how long it's been on. Remember, the constriction cuts off the blood supply to all tissues lower to it and leaving a TQN on for long periods risks damage to lower limbs.

Shock/Poor Perfusion.

Shock and the management of shock is discussed in more details in the Chapter 7 – the Clinical FAQ.

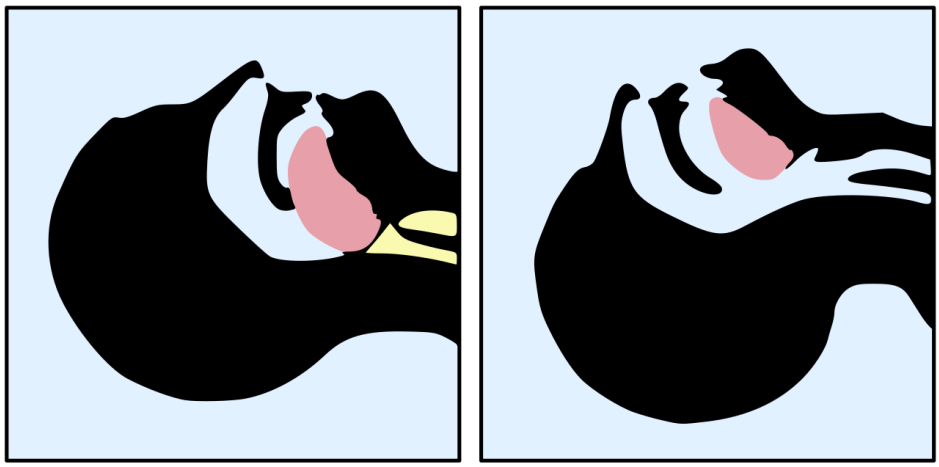
Airway:

Ensure that the casualty can breathe by checking and, if needed, protecting their airway. If unconscious, a person is at risk of aspirating vomit or blood, or their tongue may fall back and block off the airway, causing them to suffocate. A conscious person generally protects his or her own airway – their swallow mechanism and gag reflex is still functioning. An unconscious person may require you to secure their airway. This is largely the practice of preventing the tongue from falling back in the throat and blocking the airway. Failing to do so will result in death within minutes. A silent airway (no air moving in an out making noise) may indicate total airway obstruction. Snoring, gurgling or stridor may indicate a partial airway obstruction possibly from anatomical or mechanical causes.

Manual Control:

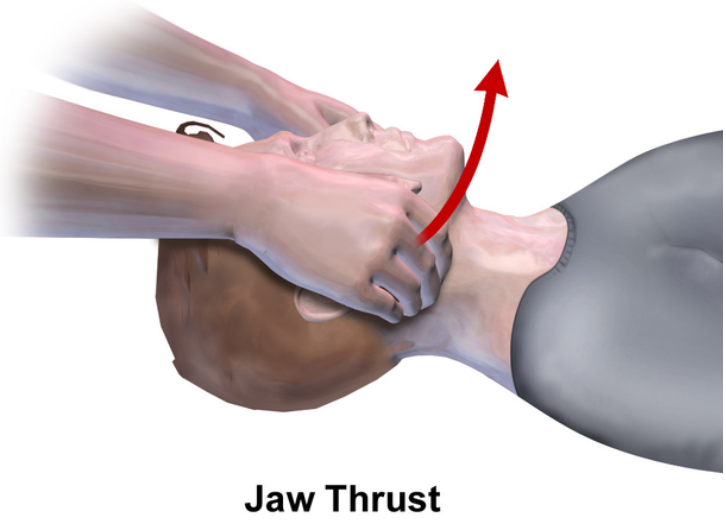
1) Usual positioning the patient on their side with their head in a small degree of extension is all that is required for most people to maintain their airway.

2) Head-tilt-chin lift offers another alternative – tilt the head backwards slightly and lift the chin up usually opens the airway, especially in conjunction with a jaw thrust



Reposition of the head with a head-tilt-chin-lift, demonstrating how it can open the airway. Wiki commons

3) Jaw thrust (best used in the casualty with a suspected spinal injury). The angle of the jaw is grasp and literally lifted towards the roof – this lifts the jaw and the soft tissues attached to it forward and off the airway, opening it.



Jaw thrust. Wiki commons

Position the patient on their side. The only unconscious people who should ever be flat on their back are those undergoing CPR, those with spinal injuries or those who already have a semi/definitive airway like a supra-glottic airway or endotracheal tube. Everyone else should be positioned on their right side or in the recovery position – which is discussed later in this chapter.

Debris and vomit:

Vomit and foreign bodies (teeth, dirt, snow, etc.) can block the airway. This is best removed by scooping out with your fingers whilst using care not to further impact the material into the airway. Care must be taken when placing your fingers into someone's mouth as the semi-couscous person can bite down without warning. The process of clearing vomitus can also be aided by tilting the casualty to the left or right thereby keeping the vomit out of the airway by allowing gravity to assist in its removal. Always be prepared for the unconscious casualty to unexpectedly vomit!

There are a few commercially available suction devices on the market that do not require power and are manually operated (such as the V-Vac or NAR tactical suction device). Likewise, there are several commercially available suction devices on the market that can be used with batteries, 12 volt or household current. An improvised suction device can be made with a catheter tipped 60ml syringe attached to a nasal airway. Finally, for foreign bodies an instrument called the Magill forceps can prove useful when used with a tongue blade, especially if the object is deeper into the airway.

Airway Adjuncts:

The purpose of an airway adjunct is to assist in keeping the airway open and specifically the tongue out of the airway. These are small and inexpensive but require some skills to use and most importantly need to be correctly sized. They include the oral airway and the nasal pharyngeal airway. Practice before

using. In a survival situation, if required, you can also take the tongue and using a safety pin secure it to the lower lip there by keeping out of the airway. All airway adjuncts must be removed as the casualty regains consciousness – usually the patient will do it for you by removing themselves or coughing and spluttering enough for you to know it needs to come out.

Oral and nasal airways:

These include oral pharyngeal airways and nasal airways. These are very useful for offering a simple solution for helping maintain the airway of an unconscious patient. But they offer no protection from aspiration. Their use is easy to learn and their simplicity shouldn't make you under-estimate how effective they are in supporting the airway.

selection of different sized oral airways

Supra-glottic airways (SGAs):

A SGA's secures the airway above the vocal cords. They are also known as blind insertion airway devices as they do not require you to visualize the vocal cords (a somewhat difficult thing to do) to use them. These devices are easy to use but do require some psychomotor skill and correct sizing. As such their use should be practiced under competent instruction prior to an actual emergency. Common SGA devices include the Combitube, King LT-D, airway intubating laryngeal airway (ILA, air-Q) and the laryngeal mask airway. These allow ventilation while minimizing (but not eliminating) the risk of aspiration of stomach contents into the lungs. Frequent reassessment is required to ensure the SGA is in the correct location.

Generally, SGA's are placed by size: Large adult / standard adult / Small adult etc or by the patients estimated weight.

Correct placement of an i-Gel supra-glottic airway. Igel.

Intubation:

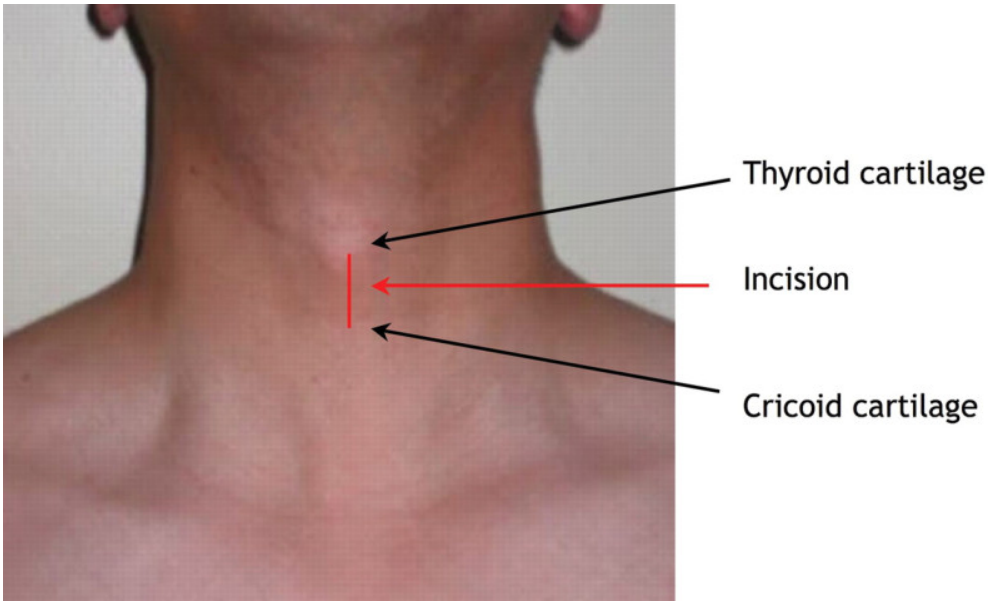
Intubation is the gold-standard for airway control. It however requires the most skill and equipment. Constant practice is required to maintain the skill of passing the correctly sized tube between the vocal cords (which is more difficult than it sounds, especially in a survival environment) and then ensuring it is in the right location in the airway. There are several ways intubation can be performed including orally, nasally, blind, digitally and wire guided with or without pharmacological adjuncts such as sedatives and paralytics.

Surgical:

There are times when the face / upper airway has been subjected to so much trauma that surgical airway is required. This is a skilled procedure that involves cutting a hole in the neck below the vocal cords to make a new airway. This is most commonly done by a cricothyrotomy. Once again pre-emergency training is required along with a few simple supplies but it is a very simple procedure – we have described it here – formally teaching is recommended. There are also several very good YouTube videos describing the procedure

Indication:	obstructed or partially obstructed airway, and an inability to maintain it with simple techniques or adjuncts
Equipment:	Scalpel Bougie or skin hook/ tracheal hook Size 6 or small endotracheal tube.
Technique:	Clean the anterior neck Identify the cricoid membrane Make an incision in the mid-line from mid-point of the larynx down to below the cricoid ring

Quickly dissect down onto the membrane and puncture it with the scalpel and place the hook or bougie through hole into the larynx
Rail-road the endotracheal tube over the bougie into the trachea and inflate the balloon.



anatomical landmarks for a surgical airway

When to remove:

In traditional pre-hospital care the surgical airway tube is removed and the wound in the neck is closed (in standard wound closure fashion) when the patient is either awake and able to maintain the airway for themselves or when they have had an endotracheal tube in place.

In a prolonged austere situation, it is likely that the first situation will be the most common situation and removal of the surgical airway doesn't occur until the patient has awakened.

Breathing:

Once you know that the airway is open, make sure the casualty is breathing.

Assess:

1) is the casualty breathing?
2) at what rate?
3) at what depth?
4) at what regularity?

If the casualty is not breathing/sub-optimally breathing, you will need to do this for them. This can be done:

1) Manually using mouth-to-mouth, mouth-to-nose, or mouth-to-face mask/shield. The facemask or shield provide a one-way value and make this process more palatable. Ventilations are given once every five to six seconds for an adult. The facemask can be supplemented with oxygen, if available.

2) Manually using a bag-valve mask. These devices deliver upto1600 mL of air to the casualty each time they are squeezed – the patient only needs 500-600mls per breath, so they only need a 1/3rd of a squeeze. They are inexpensive but require more skill then expected to use correctly (getting a correct mask seal can be quite challenging). You need to practice in advance. They can be used with one or two rescuers (best with two) and with or without supplemental oxygen. They can be connected directly to a SGA or to an endotracheal tube.

3) Mechanically using a flow-restricted oxygen powered ventilating device (FROPVD) or ventilator. Both devices require advanced training but are available on auction sites. Care should be used with the FROPVD as it consumes large quantities of oxygen and will not work on an oxygen generator. If one is procuring a ventilator it should be air-powered, versus oxygen powered thereby eliminating the requirement for bottled oxygen.

In a survival situation, hard decisions on how long to continue ventilation before stopping must be made. The casualty in a remote/survival medicine situation which requires prolonged ventilation is unlikely to survive.

Supplemental oxygen can be given to all casualties who are not breathing or who have a low oxygen saturation when examined with a pulse oximeter. In the remote, austere, or survival situation bottled oxygen is problematic. This leaves the provider with four options:

1) Do not provide supplemental oxygen;

2) Use an oxygen concentrator. These devices are available on auction sites and take the ambient air and concentrate the oxygen within it. Rates of 5 to 10 liters per minute are achievable. An example is the Devilbiss oxygen concentrator;

3) Use oxygen from pre-filled bottles. This is a finite resource, which is problematic to move in any quantity, and

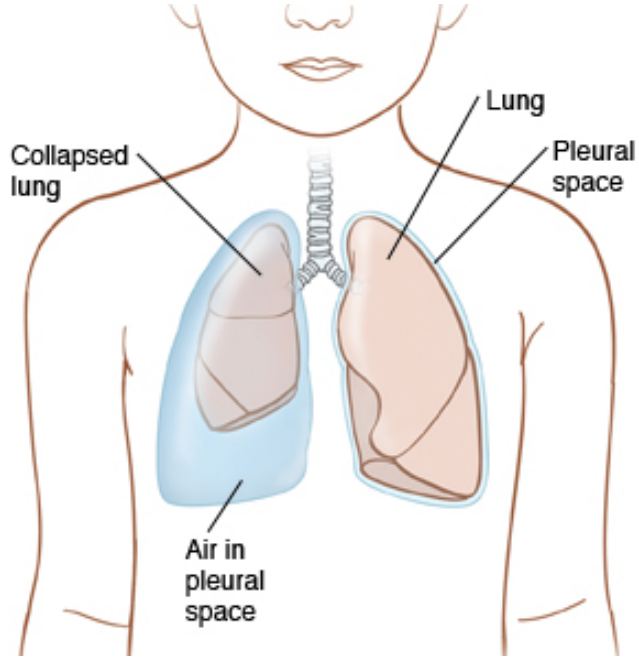
4) Make and/or bottle your own oxygen using an oxygen generator. These devices are available on the commercial market. An example is the Portable Oxygen Generation System by On Site.

Pneumothorax

In the emergency setting, this condition is usually caused by penetrating trauma to the chest wall. When the chest cavity is punctured, or opened, the vacuum that allows the lungs to move air is broken and air from the outside world rushes into the thorax. The lung can no longer exchange oxygen like it should. The air from outside will remain unless it removed but first the puncture wound (if present) needs to be closed to prevent more air from moving in. Generally, once the wound is closed the body will reabsorb the air over 6-8 weeks.

A tension pneumothorax occurs when the air inside the pleural space becomes pressurized due to a flutter valve effect with the hole into the pleural space i.e. the air can continue to leak in as the patient

breaths, but it cannot get out → hence the pressure in the space rises with each breath. The treatment of a tension pneumothorax is needle decompression.



pneumothorax – air in the pleural space with a collapsed lung (wiki-commons)

Needle Decompression. If a casualty has a tension pneumothorax, then it needs to be decompressed if that is within the skills set of the provider and available equipment. In this procedure, a large-bore (14 gauge or 8 French), long (9 cm) needle is placed into the chest to decompress the pleural space. This procedure is in the realm of survival medicine but requires some pre-emergency training and equipment. The skill involves recognizing the tension pneumothorax (from other chest injuries), placing the needle, managing the catheter post-insertion and evaluating for success. The more advanced intervention, the insertion of a chest tube, is only in the realm of advanced survival medical practitioners who are well resourced and it is beyond the scope of this book.

Recognition: shortness of breath, signs of poor perfusion, reduced air-entry on the side of the pneumothorax and hyper-resonant percussion characterize a tension pneumothorax. The key here is that most pneumothoracies will get better by themselves so the trigger to decompress a chest relies on signs of a pneumothorax plus severe cardiovascular instability.

Technique: The technique involves identifying the 4th intercostal space in the anterior axillary line, cleaning the skin and inserting the needle until enter the pleural space and hopefully hear a hissing release of air under pressure. Best case is you treat a life-threatening problem and worst case is you create an open pneumothorax where there was none. The insertion and subsequent care of the catheter needs to be kept as sterile as possible – a real risk with this procedure is subsequent life threatening infection.

After-care: The question is – when can you remove the needle or catheter? You have created an open pneumothorax by inserting the needle and hopefully alleviated or partially alleviated the tension. In a hospital environment, these patients progress to a chest drain, but in a survival or austere environment

that is not generally possible. If the patient's symptoms have improved or resolved then the catheter can be removed and if possible an airtight dressing placed over the hole. The body will resolve a simple pneumothorax – it will take 6-8 weeks but it will resolve.

Open chest wounds. There is a hole in the chest it needs to be covered. This can be done with the casualty's hand or a gloved hand initially and then replaced with a occlusive dressing. Open chest wounds need to be closed so the connection between the pleural place and the external environment is closed off. In the absence of a chest drain the patient will have potentially a large pneumothorax but provided the air-leak is closed and you manage to prevent or treat an infection the pneumothorax will resolve spontaneously.

Circulation:

Circulation involves managing problems with:

1) The heart – is it beating?
2) Control of bleeding – which is discussed above.

CPR in Austere Environments:

If the heart is not beating then you need to beat for it. These are skills best learnt in a Cardio-Pulmonary Resuscitation (CPR) course. Broadly it is the compression of the chest to generate pressures within the chest to move blood through the heart and provide a small but hopefully lifesaving amount of circulation until the heart is restarted either electrically (with a defibrillator) or chemically (with a drug like adrenaline).

Is there any point in doing CPR in an austere environment?

To decide when and how long to do CPR for you need to understand what CPR is for and what it does. CPR is only a short-term treatment to try and keep the patient alive until they can be defibrillated.

The classic teaching has always been that CPR should be continued until the rescuer is either too exhausted to continue or a defibrillator arrives. If you do not have a defibrillator in an SHTF-scenario then it is reasonable to stop after 20 minutes if there has been no response to CPR.

If a defibrillator is available it is appropriate to administer up to 10 shocks (every 3-4 minutes) over 30 minutes and, if this doesn't result in spontaneous cardiac output, to stop.

There is sub-group of patients where CPR is part of trying to re-oxygenate the patient, where the patient's primary problem is that they have been deprived of oxygen and by improving their oxygenation hopefully the heart will re-start spontaneously. These are patients who have drowned, asphyxiated or hung themselves. There is also a special case of patients who have suffered a cardiac arrest due to anaphylaxis (due to a severe allergic reaction) where the treatment is intravenous adrenaline and lots of intravenous fluids and defibrillation is usually not part of the treatment. For these groups, CPR should be

continued for 45 minutes before stopping with a focus on oxygenation (airway management and ventilation) or specific treatment of the causes (as in anaphylaxis – lots of adrenaline and fluid intravenously).

Disability:

The casualty should be evaluated for their level of neurological functioning. This is often done by:

1) Speaking to the casualty:
Do they know who they are? Where they are? When it is?

or, if unconscious:

2) Challenging with painful stimulus such as nail bed pressure or a sternal rub.

This will allow you to assign the score of A – Alert, V – Verbal, P – Painful, or U – Unresponsive.

The pupils can also be assessed now for size, shape, equality and reaction to light.

Exposure:

The unconscious casualty should be exposed from head to toe to inspect for any missed injuries. This is most commonly done with trauma sheers but in the survival environment taking the time to undress, if possible, is warranted to prevent the destruction of limited garments. Take the time to do a head-to-toe examination looking for hidden injuries.

The Next Steps:

Once exposed, the casualty should be packaged to keep warm and protected from the environment.

Full Set of Vital Signs:

Now that you have searched for and treated everything that will immediate kill the casualty you have some time to look for other problems and provide some support. A good starting point is a full set of vital signs. This includes, pulse, respiration, blood pressure and temperature and pulse oximetery if available. Vital signs are useless if they are not recorded. Write them down for you will need to compare with future assessments.

Depending on the injuries you may consider placing a urinary catheter at this point to monitor urinary output which is a useful thing in survival situations. This is a skill that requires some pre-emergency training and equipment but is generally safe when performed correctly.

Give Comfort:

Manage pain. This can be done pharmacologically with medications or by using hot/cold compresses, positioning, splinting, distraction, humor, acupressure, acupuncture, relaxation exercises, guided imagery, etc.

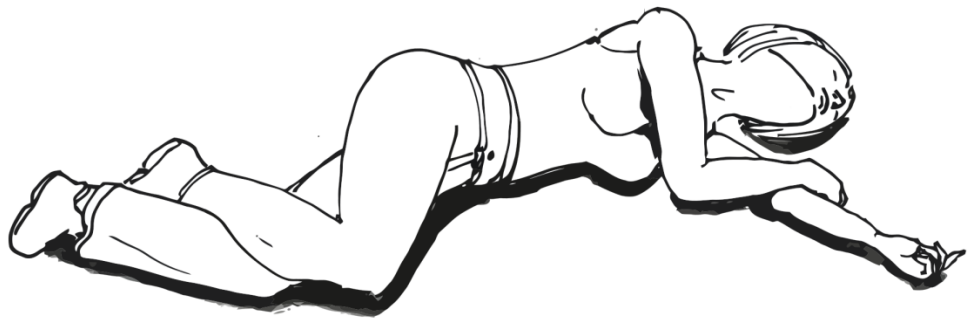
Consider decompressing the stomach, if warranted, with a naso/oro gastric tube. This is a skill that requires some pre-emergency training and equipment but is generally safe when performed correctly in an austere environment, and is not difficult to learn.

Inspect the Backside:

At this point you should take a minute and conduct a deliberate inspection of the posterior surfaces of your casualty to ensure that you have not missed any important trauma. This may require the assistance of several people to perform safely.

Position the Patient:

Where possible the patient should be placed on their right side (the left side is fine too – there is a theoretical advantage of reducing the risk of stomach fluid aspiration by placing the stomach downwards on the right side). This is generally known as the 'recovery' or 'rescue' position. There are a number of slightly different positions described, but ultimately, they all involve lying the patient on their side and using their arms and legs to stabilise them in that position.



recovery or left lateral position for an unconscious patient

Part 2 - Prolonged Field Care:

This is a new name developed by the US Special Operations community to describe the extended field critical care which follows the initial first aid/pre-hospital care which has been occurring in remote and austere practice for years in both military and civilian practice, but without a label.

The remainder of this chapter is focused on the provision of prolonged or definitive care in the field/ non-hospital environment.

There are 10 principals of PFC (as described by www.prolongedfieldcare.org) - they don't universally apply in a truly austere or survival situation but do provide a nice frame work for continuing resuscitative care beyond First Aid and they flag the important considerations for austere critical care.

For each principal, three different levels of care are defined, to provide a standard to measure care by. "The Minimum" – what should be possible to provide in a truly field/austere environment (what can be carried in a backpack). "Better" – what can be provided in dedicated facility (albeit, a small primitive one or based out of a vehicle) and finally "The Best" – what can be provided in a dedicated field- based critical care space or within an evacuation aircraft. Within the context of survival medicine, we will frequently be happy to achieve the minimum, and that will be at the limit of what is possible for the amature medic, but the definitions are helpful to define the level of care you are aiming to provide from a training and logistic perspective – and if you have increasing levels of medical care, it will give you a framework to work within.

1. Monitor the patient to create a useful vital signs trend – which helps both develop and define your differential, but also to define progress. As discussed in the assessment chapter, a single set of vital signs is only of limited value (although useful). The true value of vital signs is in their trends. Is the patient getting better or worse? Is the patient responding to treatment or not? How the patient looks can lag (sometimes several hours) behind changes in vital signs – so regular measurements give you a pattern to interpret. Recording the measured vital signs (preferably in a graph form to easily see the trends). Vital signs should be measured every 3-4 hours if seriously unwell and 12 hourly if stable.

Minimum: Blood pressure cuff, stethoscope, pulse-oximeter, Foley catheter (to measure urine output), mental status, and an understanding of vital signs interpretation.
Better: add Capnometry – to measure the presence or absence of CO2 on someone's breath.
Best: an electronic vital sign monitor to provide hands-free vital signs data at regular intervals

2. **Resuscitate** the patient beyond crystalloid/colloid infusion. While giving intravenous normal saline can be lifesaving, in trauma anything beyond 1-2 liters is almost certainly bad for the patient – although so is having no blood pressure – so it is a balance of risk. If someone has lost blood then the best fluid to replace that blood with is blood. The rules are different when the patient hasn't lost blood (hypovolemia) and their low BP is due to dehydration, loss from burns or another form of shock, but in trauma – blood needs to be replaced with blood if possible.

Minimum: field-fresh whole blood (FWB) transfusion kits. These kits have revolutionized the provision of field critical care and enabled blood to be safely collected and re-administered in a field environment.
Better: the addition of maintenance crystalloids for a major burn, sick medical patient and/or closed head injury resuscitation (two to three cases of normal saline, lactated Ringer's solution or Plasmalyte); the availability of a way to warm fluid.
Best: of limited applicability to our situation would be to maintain a stock of packed red blood cells, fresh frozen plasma, and have type-specific donors identified for immediate whole blood draw.

3. **Ventilate/Oxygenate** the patient. The ability to get oxygen into a patient who isn't breathing well or at all and the CO2 (the waste gas) out is fundamental to field- critical care.

Minimum: to be able to provide positive end-expiratory pressure (PEEP) via bag-valve mask (you cannot really ventilate a patient in a field setting [prolonged ventilation] without PEEP or they will be at risk of developing acute respiratory distress syndrome). Hand ventilating a patient is a logistically a challenge but is possible.
Better: to be able to provide supplemental oxygen (O2) via an oxygen concentrator (as discussed above).
Best: portable mechanical ventilator (i.e. Eagle Impact ventilator [Zoll Medical Corp., http://www.impact instrumentation.com] or similar) with supplemental O2.

4. Gain Definitive Control of the Patient's Airway with a cuffed tube in the trachea (and to be able to keep the patient comfortable) during spontaneous or assisted ventilation through the tube. Practically in an austere situation the ability to have a cuffed tube in the trachea may not be possible. A sub-optimal, but acceptable alternative is a cuff- less supra-glottic airway such as an laryngeal mask airway or an iGEL.

Minimum: medic is prepared for a (+/-) ketamine cricothyrotomy/surgical airway
Better: add ability to provide long-duration sedation if the patient requires help with their breathing.
Best: add the ability to perform rapid-sequence intubation capability with subsequent airway maintenance skills, in addition to providing long-term sedation (to include suction and paralysis with adequate sedation).

5. Use Sedation/Pain Control to accomplish the above tasks. This requires both access to the drugs and the knowledge to safely use them. This requires training and authorization – both of which are challenging, but not impossible to achieve. The authors have provide non-career trained "medics" with these drugs in defined circumstances, so it is possible.

Minimum: provide opiate analgesics titrated intravenously.
Better: trained to sedate with ketamine (and adjunctive midazolam as needed)
Best: experienced with and maintains currency in long-term sedation practice using intravenous morphine, ketamine, midazolam, fentanyl, and so forth.

6. Use Physical Examination/Diagnostic Measures to gain awareness of potential problems and monitor the evolution of a patient's illness or injury. Physical assessment is described in more detail in Chapter 5 on Clinical Assessment. It is worth reiterating again that the best approach to recognizing the abnormal is to repeatedly examine and assess patients who are normal.

Minimum: can use physical examination without advanced diagnostics with a view to picking up on unseen injuries (abdominal bleed, head injury, and so forth).
Better: trained to use advanced diagnostics such as ultrasound and point-of-care laboratory testing – urine dipstick, simple blood analysis etc.
Best: experienced in the more advanced interpretation of the above.

7. **Provide Nursing/Hygiene/Comfort Measures**. This is important and is addressed in more detail in *Chapter 20 – Nursing Care in an Austere Environment*.

Minimum: ensure the patient is clean, warm, dry, padded, catheterized, and provides basic wound care. If you are unable to catheterize the patient, you can use nappies (diapers) and calculate the amount of urine produced by measuring the wet and dry weight of the nappy (diaper).
Better: use a bed with the ability to position elevate head of bed, or to tilt the bed; debride wounds, perform washouts, wet-to-dry dressings, decompress the stomach with a nasogastric tube – can be used to both drain the stomach, but also feed the patient. If the patient is conscious this can be given orally for them to swallow – however due to slow gut movement absorption can prolonged, so small frequent meals may be a better option. For patients who are unconscious the only practical option is feeding them via a nasogastric tube. A slurry can be made of 6 parts dried skin milk/7 parts cooking oil/3 parts sugar – add 100mls solution to 400ml boiled water. 1500-2000 mls per day – this provides adequate hydration and sufficient calories, while providing adequate protein as well.
Best: experienced in the provision of all the above.

8. **Perform Advanced Surgical Interventions** in an austere environment.

Minimum: the knowledge, skills and equipment to undertake simple surgical techniques – simple wound closure, chest tubes, cricothyrotomy
Better: the knowledge, skill and equipment to undertake more complicated surgical intervention - wound debridement, limb amputation.
Best: experience with all the of the above, and the potential to undertake more complicated procedures in a life or death scenario.

9. **Perform Tele-medicine** consult. This is probably not applicable in a true survival/SHTF situation, although conceivably there may be access to clinical support professionals out of theatre/out of the immediate environment who may be able to offer suggestions and advice.

Minimum: make reliable voice communications – present the patient, pass on trends of key vital signs
Better: add laboratory findings and ultrasound images
Best: video teleconference

10. **Prepare the Patient for Flight/Transport**. This is also not usually applicable in most survival situations – although there may be the occasional situation where the patient may be able to be "evacuated" within the austere environment – from a situation with minimal care to a situation where better or the best care is available. Moving a patient who is seriously ill can be a challenge and is not simply a case of carrying a stretcher or putting them in the bed of a pick-up. The care they have been receiving needs to be continued

Minimum: be familiar with the physiologic stressors of flight/transport
Better: be trained in critical care transport
Best: have experience in critical care transport.

Another useful pneumonic to help you remember ongoing care requirements, after initial resuscitation is **HITMAN**:

H. Hydration/Hypothermia – keep the patient hydrated and prevent hypothermia.
I. Infection – minimize risk of infection, recognize and treat infection.
T. Tubes – managing tube – IV lines, naso-gastric tubes, indwelling catheters.
M. Medications – make sure the patient is receiving the appropriate medications by the appropriate route.
A. Analgesia – keep the patient comfortable both physically and pharmacologically.
N. Nutrition – the sick need nutrition to get better - protein is particularly important.

PFC provides a framework for you to consider the on-going critical care requirements for austere critical care – the assumption within PFC is that the care is prolonged for hours to days. The difference with our situation is it is potentially for weeks to months.

Their model remains valid however, in that if our critically ill patients have not substantially improved within a few days to a week then the outcome will be poor, as austere critical care cannot be continued in a truly "grid-down" austere environment – resources, both human and material, limit how long austere critical can be applied. One complicated patient could consume all your groups' medical supplies within a few days and there is the potential to need to ration or triage who gets care and what supplies are used.

The patient will either get better (to the degree they can be relatively independent) or they will die.

What If the Patient Dies?

Seriously ill and injured patients in a low tech/austere environment will die. Even with modern critical care and everything modern medicine can offer, people still die. In an austere situation, the death rate will be much higher. Most patients who are critically ill will die. It is a simple fact. When you will not be able to save everyone, some people will die.

The process of dying

Depending on the cause, death may be a quick or prolonged process. Someone dying of an end stage disease like cancer or due to over whelming infection or slowly succumbing to major trauma normally follows a process like this:

1. Reducing level of conscious state over several hours (to a day) until not responding at all.

2. Progressively irregular breathing with increasingly lengthy pauses between breathes until they stop. Sometimes this can take several hours and pauses can be quite long. Just when you think they have died, they take another breath. This is often associated with noisy "wet" sounding breathing or "gasping" for breath. Usually the patient isn't in any distress, but it can be distressing for family witnessing this.
3. Progressively falling blood pressure and loss of peripheral pulses (usually they are lost in this order: radial, femoral, carotid). Loss of carotid pulses generally means someone is dead.

How can I tell if someone is dead?

No pulse.
No breathing.
No heart sounds.
No pupil response to light.

Check, leave the body alone and recheck after 30 minutes to be sure.

Hypothermia Note: precautions need to be taken where the person concerned has been in the extreme cold, either the snow or very cold water. Severe hypothermia causes a profound slowing in the body's metabolism and therefore can mimic death. Hence the saying "You are not dead, until you are warm and dead ". That said, this statement only really applies to snow melt and in cold environments.

Contrary to what television teaches, the eyelids do not close when someone dies. They will remain open unless someone else closes them.

Following death, the muscles of the body relax initially and the body will be floppy with no tone. Then a process called rigor mortis begins and the body becomes very stiff and will hold the position it is in. Rigor mortis begins 2 hours after death and is generally complete around 18 hours post mortem. It may be present for one to two days after death, depending on the climate, then the body becomes flaccid once again.

What should I do with the body?

The human body begins to decompose rather quickly after death. Just how long it will take to begin to stink depends on the ambient temperature outside. If it is very hot, you may have only 8 hours or less. In a cooler climate, however, it could take 24-36 hours. Frozen, the body will not decompose until it is thawed.

A decomposing body rapidly becomes a health hazard and should be buried as soon as possible. The body is usually safe to handle and all that is required is basic hygiene after touching it (wash your hands). If the person died of infectious causes, you should be much more cautious when handling the body to avoid contracting the illness yourself.

A dead person should be buried quickly in a reasonably deep grave to avoid predation by scavengers. Most religions have short rites for the burying of the dead but for the non-religious a favourite poem may be appropriate.

It is important to document not only the fact that someone has died, but also the circumstances of the death, your guess as to a cause of death, and how the body was disposed of. This becomes important for legal reasons should things return to normal or in the case of an isolated expedition for the coroner on your return.

Chapter 7: Clinical FAQ's

In the last edition of this book we shied away from providing too much information about the management of specific clinical conditions. With this edition, we have expanded disease specific clinical information significantly, while much is covered in specific chapters, this chapter uses a question and answer format to address some of the common questions we have heard asked in various settings – on discussion forums, within our circles of friends and at various survival medicine gatherings and courses.

This section is not comprehensive and we recommend the Hesperian Foundation book – "Where There Is No Doctor" as a great starting point for the novice. The reference section contains a detailed description of potentially appropriate books. Within limitations we have tried to address the many common medical and surgical problems with a heavy slant towards a post-SHTF environment.

We have tried to give the lowest tech solutions possible to a specific clinical problem, however even then, frequently a certain level of equipment or medications are required. If you do not have the right equipment available the only option is not to do it, or to improvise, as was mentioned in the Medical Supply chapter. One of the key features of austere practice is limited resources, constrained re-supply and constant improvisation by necessity. The best reference in this regard is "Improvised Medicine" by Kenneth Iserson.

Some of the topics are by necessity brief and only tell part of a bigger story, others are a complete coverage of a topic – it should be obvious in each question.

Some Comments on Chronic Medical Problems

Many people have a chronic medical problem for which they require treatment.

The list includes:

- Diabetes – both those requiring insulins and the dietary controlled
- High blood pressure (Hypertension)
- Chronic lung disease
- Chronic renal disease
- Inflammatory bowel disease (Crohn's/Ulcerative colitis)
- Hypothyroidism (low levels of thyroid hormone)

It is not practical to cover the austere management of these in any detail here. We would urge anyone with a chronic health condition to educate themselves. Knowledge is power when it comes to managing these conditions and there are work-arounds and low- tech treatments and therapies for these problems, which while sub-optimal, could prove lifesaving. It is important to realize that very few conditions (except illnesses like insulin dependent diabetes, severe lung disease requiring oxygen) are immediately life threatening if traditional treatment is not available. Stock up on prescribed medications if you can and investigate the alternatives approaches. Some specific chronic diseases are addressed in this chapter.

A. Infectious Disease:

1. I've been stung by a lot of mosquitos and I feel terrible!

Disease carrying mosquitos are largely confined to tropical and sub-tropical area. For a large part this places most of the first world outside of the major areas of mosquito risk areas. This combined with more effect mosquito eradication programs in the west makes mosquito borne diseases a largely third world problem. This however has the potential to change with potentially increasing global temperatures and this may well make it a substantially bigger problem.

While there are many mosquito- vectored diseases we are only addressing three – Malaria, Dengue and Zika.

a. Malaria

Malaria is largely confined to tropical and sub-tropical area. There are 4 species - different species dominate in different areas. The number of people with evidence of infection is staggering – 240 million infection a year and the falciparum species is responsible for hundreds of thousands of deaths a year

Diagnosis in the austere environment is largely clinical – known malaria in an area, mosquito bites and a good clinical story. The laboratory diagnosis of malaria is discussed in the Laboratory Medicine section and while not complicated, does require basic laboratory skills.

Presentation. The classical presentation of malaria is frequent episodic high fevers, associated with headaches and severe muscle and joint pains. It can come and go depending on the exact species of malaria they have been infected with due to the fact plasmodium ovale and plasmodium vivax both have a reproductive phase in the liver – so the immune system can clear the malaria from the blood, only to have it recur when the parasites reach maturity in the liver 4-6 weeks later.

The exact pattern of the presentation depends on the type of malaria – while all species of malaria can cause death, it is only *plasmodium falciparum* which generally does cause what is referred to as cerebral malaria. Symptoms of concern in patients with malaria (suggesting falciparum is more likely) include:

Altered mental state
Reduced urine output
Respiratory distress
Jaundice (yellowing of the skin and the whites of the eyes)
Unable to sit unaided

Treatment.
Prevention is better than having to treat malaria. Fortunately, the mosquitos who transmit malaria are mostly active between dusk and daybreak and not during the day. The most effective way to avoid

infection is to wear long sleeved clothes and use mosquito repellants and to sleep with a mosquito net over your bed. Simply sleeping within a mosquito net reduces the risk by 10-fold. It is our instinct to wear short sleeved shirts and shorts in hot weather – this is worst thing you can do in an area with malaria in the mosquito population, especially at dawn and dusk.

The exact treatment of malaria depends on the country you are in and the likely species of the malaria parasite you are dealing with. It is unlikely that you will have access to the variety of medication required for all species, across all zones. Equally it is likely that this pattern will change as temperature/climate changes over the next half-centaury. The most generic drug is quinine – so if you are worried about malaria, the most useful drug to store is quinine. It is available in both IV and oral formulations – practically storing quinine 200mg tablets is probably the most useful. Adult dosage is 500mg three times a day for 5 days.

It is also possible to prevent yourself from getting infected by taking a preventer drug (a prophylactic drug) – there are a number available but the most versatile is probably Doxycycline 100mg once daily – starting three days before going into a malaria area and continuing for 3 weeks after you leave. However prophylactic medication in an austere or grid situation is not really practical.

There are a variety of other drugs which are first line treatment and prophylactic use, depending on your location in the world – www.who.org has an updated regional specific first line agents. The Centre for Disease Control in the USA also has a useful site, including traveler's information: www.cdc.gov

The herbal medicine *Artemisia annua*, has been demonstrated to be effective against malaria and has been used in China for centuries and has been refined and manufactured into a front-line therapy for malaria. It will grow in most temperate to hot climates, and if malaria is a potential problem in the future in your location you should consider cultivating this plant.

b. Dengue

One key difference between the mosquito species who transmit dengue compared to malaria is that it is active during the day as well as early mornings and evenings. This means that in areas with active dengue you must take mosquito precautions during daylight hours. Given the overlap between malaria and dengue distributions, practically it means protecting yourself from mosquitos 24/7. We tend to see dengue as epidemics (occurs episodically in numbers), although we do see sporadic cases.

You see two types of infection – dengue fever and dengue hemorrhagic fever.

Dengue Fever. This is the most common type of infection. It is characterized by high fever, headaches (it can be mistaken for meningitis infections), muscle and bone pain / aches and a widespread red rash. There is no treatment and generally they recover spontaneously.

Dengue Hemorrhagic Fever (DHF). Initially DHF looks the same as DF, however as the fever resolves the patients with DHF develop leaky capillaries – and lose volume into their sub-cutaneous tissues, their stomach cavity and lung cavities. They also develop clotting problems and bleed into the SC tissues. They tend to present with evidence of shock. Treatment is supportive with volume replacement to correct signs of shock.

c. Zika

Zika virus is generally transmitted by the Aedes species of mosquito. The Aedes species is found worldwide in tropical and sub-tropical areas (rarely in temperate climates). The Zika virus however is only found in pockets around the world – central and south America (up into Texas), the mid-two thirds of Africa, India and most of South East Asia. There are pockets of infections in some Pacific Islands.

It is also transmitted sexually between an infected and non-infected person and between mother and baby during pregnancy.

Zika is a mild viral illness – the patient may experience headaches, fevers, muscle and joint pain. In a small number of patients, it can, several weeks after the acute infection, cause an autoimmune disease called Guillain-Barré syndrome – this is rare and in an austere situation potentially fatal.

When passed from mother to baby, it can cause a disease in the baby called microcephaly – which results in severe developmental problems and mental retardation. It can also cause blindness and hearing loss.

For most people Zika infection will be trivial, the main potential problems are those of birth defects. Once established in a population it eradication is very difficult.

You should take every care to avoid mosquito bites as described above.

For a lot of other mosquito-borne diseases, eg. Barmah Forest and Ross River Fever, the treatment is symptomatic.

2. The community butcher is complaining of fever and a rash. Should I think of anything special?

Anyone who works with animals, especially if they have contact with livestock urine is at risk of a bacterial infection called Leptospirosis (Weil's disease). In endemic areas, many infections are either asymptomatic or too mild to be diagnosed – they are often confused with influenza or even malaria – but is generally seen in non-malaria areas.

The illness is characterized by a fever and widespread red rash, and may be associated with nonspecific "constitutional" symptoms including headache, myalgia, lethargy/malaise and inflamed-looking red eyes. While severe illness occurs rarely, complications may include confusion, severe headache and jaundice.

It can be contracted by using contaminated water (eg. swimming in a dam where wildlife have urinated, or using untreated tank water, where rodents have urinated on the collecting rooftops).

Treatment is largely supportive and the bacteria is very sensitive to antibiotics like Penicillin or Doxycycline.

Brucellosis and Q fever are also worth considering as a possible diagnosis. The symptoms and treatment are pretty much the same: fevers, aches and pains, treat with doxycycline. It can be contracted by using contaminated water (e.g. swimming in a dam where wildlife have urinated or using untreated tank water where rodents have urinated on the collecting roof-tops).

3. How do I treat chickenpox?

You don't really. For the clear majority of patients who catch chickenpox, the treatment is simple time and simple measures – make sure the patient stays hydrated and simple pain medicine like paracetamol (acetaminophen) for the aches and pain.

The diagnosis of CP is based on the classical presentation. Flu like illness, low grade fever combined with development of a rash – the rash starts as little red dots and these evolve into small pus filled blisters on the skin, the pustules break down and get crusty and slowly heal over a few days. They occur in crops – which means a cluster of spots will appear on one part of the body and go through the evolution process from spots to pustules and a several hours later another group of spots will appear and go through the same process. This gives you lots of different skin lesions of different ages.

Some children develop a lung infection (pneumonitis) with chicken pox and this presents as shortness of breath and cough. It can be fatal. The austere management is simple respiratory support if it is available and little else in the absence of intensive care- level facilities.

Often one of the biggest complaints is as the lesions start healing they become insanely itchy. Anti-histamines such as Loratadine or Benedryl if available may be useful as well as cool showers or baths – these lower the skin temperature and reduces blood flow to it, which reduces itch. Baking soda can also be made into a paste and spread over the area.

If a patient has been exposed to chickenpox, the virus lives in their nervous system for life, and can be reactivated, e.g. when stressed, run-down, ill, malnourished, elderly. This can lead to shingles, a very painful condition, treatable with analgesia, topical acyclovir creams (if available), and dressings to reduce skin stimulation.

Vaccinations are now available against shingles, "Zostavax", which will approximately halve the chances of shingles re-activation.

4. Do I treat fevers?

There remains debate of if there is any value to treating fever. The pro fever camp would say that fever is part of the bodies way of fighting infection and is an important part of it. The opposing group would say that having a high fever makes the patient feel awful and in medicine one of our goals is to relieve suffering so treating fever is part of that. The truth probably lies somewhere in between these two positions. If the patient has a fever and looks and feels ok, there is no need to treat the fever. If patient looks and feels awful and has the shakes or chills then treating the fever is reasonable.

Step 1. Undress the patient. Cool the room if possible. Place a wet towel over their trunk – this allows evaporative cooling to occur.

Step 2. If available administer paracetamol (acetaminophen) or ibuprofen every 4-6 hours to try and bring the fever down.

In some patients, it is not possible to return the temperature to normal, but these actions may make the patient feel more comfortable. Remember to treat the patient, not the thermometer.

5. When should I worry about a fever?

A fever is generally not dangerous. You need to decide if the patient looks sick or not. A well patient with a fever. If the patient looks well and has near normal vital signs (you are allowed a bit of a tachycardia with a fever) – then manage the fever as described above and wait and see. The actual causes of a fever can be quite varied – most will be a viral infection of some sort and occasionally a bacterial one, but if the patient looks well and continues to look well, it is likely the body's immune system is on top of the infection.

If the patient looks unwell, then you need to start looking for a reason behind the fever and make decisions around what treatment if any is needed.

Focus vs. no focus (a focus is when the cause of the infection can be tied to a specific site within the body)

- Yes? Treat identified cause:
    - Skin infection?
    - Urinary infection?
    - Chest infection?
    - Gastroenteritis?
    - Meningitis?
- No?
    - Is this heat exhaustion? Or a non-infective cause?
    - Is the patient unwell?
        - Heart rate > 110?
        - Confusion?
        - Blood pressure less than 100mg Systolic?

- Respiratory rate > 24

→ Possibly a generalized infection (aka a septicemia)

6. How do I treat someone with a severe infection who looks unwell?

The principles used in hospital also apply in an austere environment:

- Control the source – if there is an abscess drain it, if a limb has gangrene consider amputation.
- Give antibiotics if available – if you know the system involved that will give you a pointer on which antibiotic (described in more detail in the bacteria and antibiotic chapter) or if you are unsure a broad spectrum one.
- Give fluids if available – patients with sepsis are generally low on fluids. The ideal route is several liters intravenously, but small frequent amounts orally are an alternative, as are rectal or sub-cutaneous administration – which is described in more detal later in this section starting page 152.

What has been identified as lifesaving in severe infections is recognizing it as the cause of the person being unwell and the administration of early antibiotics. In the absence of antibiotics in patients who present with severe infections, the outlook is bleak – but source control and fluid therapy may be sufficient in some patients and is worth a try.

7. Worms? What are worms?

Parasitic worms look like earthworms, but smaller and some flatter. They are easily recognizable as worms. There are lots of types of worms—roundworms, hookworms, pinworms, tapeworms, skin worms. The internal worms can live in many places- the stomach, small or large intestines, liver, or lungs. Some worms live in the skin. Most of the time when someone has a worm, you will not see it come out in their stool. The adult worms can live a long time and only come out when they die. Their eggs are very small (microscopic) so you don't see them either.

Where do they come from? Most worm eggs are passed in the stool of an infected person. After that, they can migrate out of the stool and be found in the dirt, mud, grass and food (when people don't wash their hands before cooking). In temperate climates, the guinea worm egg is found in the water. Some worms can be caught by eating undercooked meat or flour contaminated with flour beetles. Occasionally, worms can be passed from an animal to a human.

Why are they harmful? A worm must take its nutrients from its host—you. Hookworms, for example, have sharp little teeth that they use to attach themselves to the lining of the small intestines and suck blood. Having many hookworms can cause a person to lose enough blood to become anemic. Other worms just hang out and absorb nutrients as they pass through the digestive system. Some adult worms

live in the skin of their host and cause intense itching and pain. They are generally bad because they take nutrients from you, who will likely need them in a collapse scenario.

Symptoms are varied but can include weight loss, abdominal pain, perianal (around the bum) itch and even worms crawling out your nose or from your bum. The laboratory chapter describes some simple tests for worms in the stools.

Personal and camp hygiene is the best preventative measure against developing worm infection – Use good hygiene and wash, wash, wash! Even with impeccable hygiene standards people can still get worms. Young children should be closely monitored for rectal itching, as it is very common for them to pass pinworms amongst themselves. You should certainly wash your hands after being around small children to keep from catching them yourself.

Medication to treat worm infections are caused called anthelmintics. Unfortunately, they are not available over the counter in the United States, but in the UK, Australia and NZ these are easily accessible over the counter – stock up if you can. Agents such as mebendazole, ivermectin, niclosamide and pyrantel pamoate are good de-wormers to have. Also, easily available for purchase at your local farm store are multiple veterinary de-wormers with the same active ingredients listed above, found in the cattle/swine/goat section. While not ideal, they may work in the absence of a human labeled product – the same rules about equivalence and generic names discussed elsewhere apply here.

Natural alternatives include taking raw uncooked cloves of garlic on an empty stomach for a week or crushed pumpkin seeds (one recipe suggests mixing a tablespoon with honey and taking daily on an empty stomach for one week with a natural laxative if possible). Another natural de-wormer is the tincture of wormwood and it has anecdotal effectiveness.

In an austere situation, a therapy which is described consistently in the literature is to swallow a couple of tablespoons of kerosene. While it is bad idea in general to swallow, petroleum based products, it is unlikely this amount will cause any long-term harm and potentially will reduce the number or clear the worms from the gut.

Tobacco can be very useful in the treatment of intestinal worms – this is discussed in more detail in the Botanical medicine chapter

8. Should I vaccinate my group/children?

Ok. Where do we start?

It's a contentious area. Both groups are passionate about their positions. Our view is that generally vaccination is a good thing for certain high mortality and morbidity diseases. It is probably over used, but there are some vaccines every child in the first world should have.

The problem is that all vaccines have risks to the people who receive them – these include severe allergic reactions and brain damage. However, these risks are less than the risk of serious complications from catching the disease itself – however if you or a family member get a vaccine complication how rare the complication is, is meaningless to you.

In terms of priority of vaccines to have in our view:

1. Tetanus
2. Pertussis (whooping cough)
3. Polio
4. Diphtheria

The four of these are available in a single vaccination (eg. Adacel IPV, or Boostrix IPV)
As a rule of thumb, a vaccine may last about 10 years, but some vaccines do need to be given more often than this.

Our personal position is that the full schedule is important and lifesaving. Each parent must make a personal decision about what vaccinations their children should have. However please base your decisions on reputable sources, not a random internet site found on Google.

9. How likely is it that an infectious disease like SARS or a new strain of influenza will cause a major disaster?

It is very unlikely that a global infectious disease pandemic will sweep the world and kill 99% of the population as depicted in novels and movies. But one, which kills 10% of the population, is not impossible or even unlikely. However, the chaos the pandemic will cause may well precipitate an economic collapse/depression, and everything that goes with that. Based on historical pandemic cycles, the world will likely experience an infectious disease pandemic in the next 20-30 years, with the high rate of international travel, diseases are able to spread rapidly.

The question isn't if it will occur – but how severe it will be. It may be as mild as just a particularly bad normal influenza season or it may kill 5-10% of the population and we won't know until it occurs.

There are two things you need to know about any potential influenza pandemic to risk manage your actions. The first is the infectivity rate and the second is the kill rate. High infectivity and high kill rate is the worse combination. Low infectivity and low kill rate is the best. The actions you take:

Low infectivity / low kill rate	low risk/no special precautions
High infectivity / low kill rate	low risk/isolation or improved personal protective (PPE) activities.
Low infectivity / high kill rate	medium risk/avoidance of infection best approach – isolation + PPE
High infectivity / high kill rate	high risk/avoidance of infection

10. What is an Influenza pandemic? What is "Bird Flu" or "Pig Flu"? How do I avoid catching it?

Influenza epidemics occur every year. About 10-15% of the population suffer from influenza each year. Of those who catch it, about 1:10,000 will die – usually the elderly or infirm. Each year the influenza virus changes slightly – a slight mutation which keeps it constantly infective and explains how the infection varies from year to year. Every 15-30 years the mutation is such that it presents a completely different pattern to the body's immune system and isn't recognized which results in more widespread severe illness or a pandemic.

Influenza is also common among birds and other mammals – although usually different strains to those causing illness in humans – hence the phrase "bird or pig flu". It is possible for bird strain influenza to mutate and become infectious to humans.

It is spread by droplets – coughs or sneezes, and remains alive and active in those secretions for hours to days. The usually route of transmission is either being directly be exposed to droplets coming into contact with your respiratory mucosa or eyes or via handling something which has been contaminated (e.g. a shopping cart) and self-infecting by rubbing your contaminated hands against your mouth or eyes.

The best way to avoid catching it is simple precautions:

Avoid large crowds
Wear a N95 rated mask which fits correctly: shave properly and learn how to fit/test it.
Disinfect or wash your hands frequently – get in the habit of not rubbing your eyes or putting your hands near your face – this is hard!
If you have the option, have minimal contact with others for 6-8 weeks from the outbreak of the first case

11. Will "Tamiflu" save me from the Pandemic?

Probably not, but maybe. Tamiflu (Zanamivir®) is an antiviral agent effective against the influenza virus. It has been demonstrated that it reduces the length of the illness by 1-2 days when taken within 24 hours of onset of symptoms. There is some evidence (but not strong evidence) that if taken prophylactically starting with the first outbreaks of cases it reduces the chances of you catching influenza by several percent. But the data is very conflicted and a review mild pandemic in 2010 showed no benefit.

But will it help you to survive the Pandemic? It depends on the how the influenza strain mutates and how sensitive it is – you won't know until the time and there is a high probability it will not help. It is probably not money well spent for most people.

Another drug is amantadine. This is a treatment for Parkinson's disease, but which apparently reduces the growth of the influenza virus.

12. What about Ebola?

Ebola is from the family of hemorrhagic fever viruses and has a high infectivity rate and high kill rate. It makes it very dangerous. The only real things that Ebola and influenza have in common are that they are both viral and they both kill people.

Infection with Ebola goes through several distinct phases:

1. Asymptomatic initial phase
2. Fevers and mild GI symptoms
3. Secretory phase – severe diarrhea, vomiting, bleeding → leading generally to death over 2-4 days.

The mode of death is usually from dehydration due to the loss of excessive volumes of fluids. The saving grace is that patients with Ebola only really become highly infective in the third pre-terminal phase.

Management is primarily focused on correcting hydration and protecting health care workers who are looking after the patients from infection. The body fluids (tears, vomit, diarrhea, blood) produced by patients in this late-stage of infection are extremely infectious.

Basic personal protective equipment and good hygiene can prevent most infections but you need to be fastidious about disinfecting yourself as you remove your protective clothing after an episode of patient care.

In a third world situation (which is analogous to a post-SHTF environment) the death rate with basic care aimed at maintaining hydration is about 60%. With more first world, intensive care level care the death rate appears to be reducible to 10%.

13. My family have lice. How do I get rid of them?

There are three broad types of lice in humans:

Head lice
Body lice
Pubic lice

The specific species are relatively confined to their individual habits i.e. pubic lice will not breed in the head hair.

Lice bite you and drink a small amount of blood. The amount of blood lost is tiny and compensated for by the body. The bites are itchy and can act as a focus for infection. This can lead to cellulitis, which sometime causes an immune response which can attack membranes in the heart/kidneys, leading to valvular disease or kidney disease, similar to rheumatic fever. Cellulitis is discussed later in this section.

Head lice – the natural history of lice is that a live female adult 'jumps' (they don't really jump-spread is usually from direct contact head-to-head or sharing contaminated clothing or bedding) from an infected person to a non-infected person, lays eggs onto the shafts of individual hairs. Eggs hatch into both sexes,

mature over 7-10 days, feed on blood from biting the skin at the base of the hair follicle and reproduce again, increasing the population exponentially.

There are a variety of chemical treatments for head lice however provided you are prepared to put some time into it head lice can be treated with hair conditioner (or some other form of heavy lubricant that can be applied to the hair and then combed with a lice comb. You need a very fine comb. A standard comb is insufficient. You both smother the lice with the conditioner and mechanically remove the lice.

Failing that shaving the head is effective.

Pubic lice – shave off all the pubic hair. The same smothering strategies can be applied as for head lice but it is hardly worth it and shaving off the pubic hair in the simplest approach and essentially curative. Transmission of pubic lice is generally sexual; however, clothing and bedding can be contaminated and should be hot water washed if possible.

Body lice – In the absence of a chemical treatment the best option is all over shave and several hot washes over a few hours. Frequently clothing is infested as well – hot wash as a minimum, burning and getting new clothes if available is the best option.

14. What's pneumonia and how do I treat it?

Pneumonia is a chest infection. An infection of the breathing tubes and lung tissues. Some are viral (antibiotics will not work) and some are bacterial (antibiotics will work). There are subtly different types of chest infections but broadly the recognition and treatment are the same.

Diagnosis: The diagnosis is relatively formulaic – focal chest signs or symptoms (or a combination of them) + a fever = chest infection

e.g. Productive cough + fever = chest infection
Shortness of breath / increased respiratory effort + fever = chest infection
Sharp pain with breathing + fever = chest infection
Low SpO2 (<90%) + fever = chest infection

The full spectrum of presentations includes:

Shortness of breath/difficulty in breathing
Fever
Cough: Productive – green/grey/blood stained
Unproductive – lots of coughing with nothing to show for it
Muscle aches
Pleuritic chest pain – chest pain which is worse with deep breaths
Fast breathing rate / Fast heart rate
If it is severe → Cyanosis – a blue coloring of the fingers or around the lips or tongue.
Reduced air-entry on effected side – due to an accumulation of pus or fluid
Dull to percussion

Crackles on auscultation
Increased work of breathing
- In-drawing of the muscles of the chest wall
- Accessory muscle use – using the neck muscles to help with breathing.

Treatment:

We break patients down into two groups – those that look well and those that don't. It really is this binary.

1. **Well appearing.**

Patients who appear well are likely to have viral chest infections or an early or mild bacterial chest infection. When we say, "well appearing" they don't have to be perfect looking – often the patient looks miserable but they need to be physiologically stable with the body working normally – normal vital signs, no increase work of breathing, able to eat and drink ok and not be bed bound. They don't have to look perfect.

The approach to treatment is based around maintaining hydration, nutrition and comfort care for the patient. They should not receive antibiotics if they fall into this group. You should observe them carefully watching for any change to above findings.

2. **Sick appearing.**

These are patients who have abnormal physiology – their heart-rate is fast, their breathing is fast, they are showing signs of having to work hard at their breathing. They may be vomiting and unable to take food or fluid.

Treatment of this group consists of:

- Fluid – to maintain hydration. Orally if tolerated, but IV or SC or rectally are all options.
- Anti-pyretic (Paracetamol) (acetaminophen)– to lower fever and improved comfort.
- Antibiotics
    - Young adults – a macrolide antibiotic is first choice, followed by a penicillin based one.
    - In young children and older adults – if available they require two antibiotics. The first choice for the first would be Amoxicillin or Amoxicillin / Clavulanic acid or Cotrimoxazole. The first choice for the second would be a macrolide antibiotics.
- Deep breathing exercises are important – one of the problems with a chest infection is that the muck generated by the infection can end up deep down in the breathing tubes and contribute to worsening of the infection. Deep breathing opens these smaller tubes and encourages coughing and improved oxygenation. Encouraging the patient to specifically take deep breaths hourly is important.
- Chest percussion and positioning – for the same reason deep breathing is important – so is positioning the patient and using gentle taps on the chest wall – it loosens the muck and helps the patient cough it out.
    - Using gravity and gentle percussion
    - Position front / back / left / right
    - Gentle percussion over each area of the lung (cupped hand)

Warming and humidifying the air the patient breathes can also help.
Bromhexine (Bisolvon chesty, or Duro-tuss chesty) helps to loosen the sputum. It also helps some antibiotics (the beta-lactam family, such as penicillins/cephalosporins) penetrate the sputum.

"Bubble cpap", is where the patient breathes out via a straw/tube and blows bubbles into a bottle of water. This provides slight back-pressure when breathing out, preventing lung collapse. The vibrations from the bubbles also help loosen the sputum. This is a low tech, useful treatment for patients with chest infections.

15. Is there any non-drug therapy for skin infections like ring worm and other fungal infections?

No perfect non-drug treatments. Keep the infected area clean, dry and cool. Avoid damp and hot environments if possible. The veterinary cure for ringworm is to scrub the area daily with betadine solution. This works for livestock and most people.

Expose to UV light for prolonged periods if that is possible. Topical antifungals can be purchased OTC as treatments for athlete's foot these can be used for most ringworms if available.

Potassium permanganate ($KMnO_4$, also known as Condy's crystals) can be used. Dilute a small amount into a plastic bucket. If it is too strong, it may burn/tan the skin. Use this as a soak.

Remember to treat footwear, as well as feet, to prevent re-infection.

16. What is TB? Isn't it a disease of poverty and the Third World?

TB (Tuberculosis) is a bacterial infection caused the bug mycobacterium tuberculosis. It is a slow growing bug which likes to grow in areas of high oxygen. While not purely a disease of poverty or the Third World, it is more likely to occur in groups of people who are living in overcrowded conditions and those who are malnourished or immune-suppressed.

It is usually a chronic disease which an its onset is slow, with often years between infection and developing clinical disease. Most infected patients do not develop TB (only around 5-10%) – this is much higher if the patient is immune suppressed (elderly, HIV, other infections, poor nutrition).

It can be challenging to diagnose in the early stages of the illness, even now growing the TB bug in a lab can be difficult.

Current treatment is with a relatively complicated cocktail of antibiotics, which are generally taken for a prolonged period – 3-12 months depending on response to therapy. Worldwide multi-drug resistant TB is experiencing a resurgence – there are cases which are completely unresponsive to all anti-TB medications. Multi-drug resistant TB has a current fatality rate of 70%

There are three phases to TB infection:

- Initial infection → lesion in lung, usually contained by the immune system, low infectivity to others.
- Re-activation of lung lesion → months to years later. Moderate risk of infection. Can progress to generalized lung destruction and potentially death.
- Dissemination (Millary TB) → generally occurs in patients with a suppressed immune system and results in widespread dissemination of TB around the body. It can cause a spectrum of presentations depending where it infects – the lungs (causing a pneumonia-like presentation), the adrenal glands (usually presenting as cardiovascular collapse and shock or the brain (presenting with confusion, coma and death). Cases have been seen in the first world, with widespread movement of infected patients from overseas.

Austere treatment: Without access to TB specific antibiotics, it can be very difficult to treat and we are stuck optimizing the conditions for the body to treat itself. In these conditions, it is essentially impossible to cure the disease. The TB bacteria requires high levels of oxygen to grow well, which is why last century TB sanatoriums were in the mountains – where at higher elevations the air was relatively hypoxic. Aside from that treatment is aimed at optimizing the patient's general health – a good diet and a good physical condition.

17. What is botulism? Why is it a problem for us as survivalists/preppers?

Botulism is a disease caused by a toxin produced by the bacteria *Clostridium botulinum*. The disease itself is caused by a chemical produced by the bacteria – botulinum toxin,and not the bacteria itself. To grow, the bacteria requires an anaerobic (low or no oxygen) and a low acid to alkaline (pH greater than 4.6) environment. The bacteria produce its reproductive spores and coats its self in these spores. While the bacteria itself is easy to kill, the bacterial spores are not.

There are two options to kill botulinum spores:

- Destroy the *Clostridium botulinum* bacteria in its spore form. This requires a high-temperature treatment (121°C/270°F), water boils at 100°C/212°F, a boiling water bath cannot achieve the high temperature required; therefore, pressure canning/preserving is required.

- Create an environment in which *Clostridium botulinum* cannot reproduce. That environment is an acidic environment with a pH of 4.6 or less. This is relatively easy to do when preserving most fruits since they have a natural pH that is that low or lower.

> Vegetables like corn, beans, and cabbage, as well as all meats and fish, do not naturally have a pH that low, so water bath canning these food items creates a perfect environment for *Cl. botulinum* to grow. Foods which are not strongly acidic need to be pressure canned to ensure that the temperature of the food being preserved is held above 121 degrees C.

The botulinum toxin itself is inactivated (denatured) rapidly at temperatures greater than 80°C/180°F, so vigorously cooking/boiling is likely to inactivate the toxin in the food. However, this is not 100% certain – the botulinum toxin is so strong and so little is required to be fatal, that unless you have absolutely no choice at all (i.e. you are starving to death) any potentially contaminated food should be discarded.

You should make sure you have access to a reputable canning or preserving book (e.g. the Ball Blue Book or the USDA Home Preserving Guide) – this will list which foods can be water-bath canned and which foods require pressure canning. You can also purchase a pH meter (either food grade or a simple (but clean!) industrial one) – if the food has pH of >4.6 it must be pressure canned. If it has a pH of <4.6 it is safe to water bath preserve the food.

Clinical features of botulism:

The classical description of botulism is described as paralysis of the facial muscles, eye movement muscles and swallowing; followed by a descending paralysis of the moving and breathing muscles; combined with a normal conscious state and no fever. Sometimes the autonomic nervous system can become involved and the patient may have problems with low blood pressure, constipation and problems with urinating.

The management of botulism is primarily supportive while the illness takes it course and the administration of botulinum anti-toxin. In an austere environment, it is likely that treatment will be limited to basic nursing care and, if within your scope, ventilating the patient for 6-8 weeks. Ventilation for such a prolonged period is likely to be not logistically possible unless you have access power and a portable ventilator, or a lot of people to share the hand-ventilation with.

Within modern health services the mortality rate for those admitted with paralysis is 5-10%. With no treatment 50% of patients will survive – primarily those who do not suffer from respiratory paralysis.

B. Trauma and Burns:

1. How do I manage a GSW to the gut?

This is a commonly litigated question on preparedness boards of how to treat an abdominal “gut shot” gunshot wound. There are the totally pessimistic and the pretty pessimistic and that sums up the commonly presented views.

There is however a slightly more optimistic middle ground. If you look at medical history the mortality of "gut shot" patients were not anywhere near 100%. Depending on exactly when and where and which historical textbook your reading survival is described as variably from 5-50% - there clearly are a few variables at play!

Abdominal GSW's can be classified into three groups:

1. Penetration into fat and muscle only
2. Penetration into the peritoneal cavity only
3. Penetration into the peritoneal cavity with bowel and/or blood vessel damage

Penetration into fat and muscle only: If the wound is keep clean and any dead tissue is removed, they are allowed to heal from secondary intention (see Chapter 11 on Wounds) and any local infection treated, these wounds are completely survivable and the patient will do well.

Penetration into the peritoneal cavity only: If no bowel or blood vessels are injured and provided the abdominal cavity is well irrigated (5-10 liters) with sterile water or normal saline, the skin wound is then closed. With this approach, most patients will survive. The problem is, it is almost impossible to know if the bowel has been injured or not – you may see fecal material coming from the wound or torrential hemorrhage from the wound – but for the majority, the injuries may be subtle and it may be impossible to tell initially. From the survival medicine perspective, the only real option is to treat all the abdominal GSW's encountered this way and cross your fingers. Those with significant bowel injuries will likely die.

Penetration into the peritoneal cavity with bowel and/or blood vessels involvement is pretty much universally fatal in the absence of proper anesthetic, a knowledgeable surgical skill set and antibiotics.

Of these three groups the first two are eminently survivable if managed appropriately – the third group is also potentially survivable as discussed above but clearly less so.

2. How about if it's a GSW leg instead?

It's a different kettle of fish to a gut shot completely. A simple flesh shot can generally be managed relatively easily and is discussed in more detail in Chapter 11 – the wounds need to be cleaned, debrided (all the dead tissue removed) and allowed to heal from secondary intention. This is significantly complicated if bone or blood vessels are damaged along the track of the bullet.

3. How do I classify types of burns?

Burns are classified by the type of heat energy that causes them and also by the degree of damage the burn does to the skin of the body.

Energy types:

Thermal energy burns are caused by exposure to excessive heat
Electrical – are caused by direct contact with electricity.
Chemical – are caused by contact with chemicals.

Radiation/Radio wave – are caused by exposure to radio waves or radiation

Damage classifications:

Superficial
Previously known as a first degree burn, they are painful, red, and the skin is intact. The redness blanches with pressure. This includes sunburn, low intensity flash burns, and brief thermal contact. Pain is the major issue to deal with. With superficial burns, they heal without scarring and there is minimal systemic response. When calculating the percentage burnt we do not include superficial burns.

Partial thickness
Previously known as second degree burns. We further break partial thickness burns down into superficial partial thickness and deep partial thickness.

An example of superficial partial thickness burn would be one which looks otherwise like a superficial burn, but blistering of the skin has occurred. Typically these burns are painful. Generally, these burns blister and can appear moist. They are usually caused by high intensity flash burns, hot grease, steam, or flame.

Infection, swelling, and pain are the primary initial concerns. Dehydration may develop over time with large body surface area burns due to fluid loss through the burn and into damaged tissues. There is much more of a systemic response with partial thickness burns.

photo showing mostly partial thickness burns, with a small area of full thickness in the lower left of the photo.

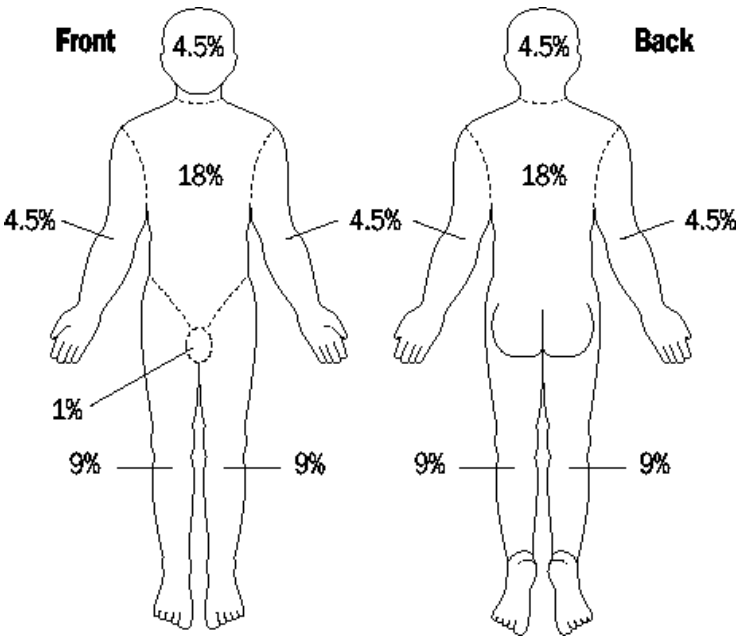
Full
Previously known as third degree burns. The burn is through both layers of the skin (epidermis and dermis) and into the subcutaneous fat and deeper structures. This is tissue that looks burnt and charred. These may appear white and waxen or may be charred (known as eschar). While overall the patient with severe burns is in significant pain, full thickness burns are much more likely to have no sensation. Capillary refill is absent. Like partial thickness burns, the primary concerns are infection, pain control, and severe swelling. Full thickness burns do not heal and trigger a major systemic response. The only treatment is excision (and skin grafting) or amputation.

With all burns, but especially with extensive partial and full thickness burns, a systemic response occures. This is a major physiological stress, equally severe as major trauma or blood loss. The body responds with stress response: there is increased cardiovascular activity and increased metabolic activity – the body starts to use muscle mass for energy. This is a key reason patients with severe burns need a high protein diet to help with recovery and rebuilding the damaged skin and structure.

The size of the area burned

Determining the area of the body which has been burned is important in determining both treatment and likely outcome.

Superficial burns heal quickly and do not contribute to the total body inflammatory response we see in burns. We only consider partial and full thickness burns in calculating percentage of the the body surface area which has been burnt. The rule of nines (below) helps you figure out the area burnt. When you are looking at small areas – use the person's palm as 1% and map the size the palm against the burnt area to help calculate the percentage burnt.



Rule of nines

4. I was reading about treating burns. It got really complicated quick – what do I need to know?

a. Initial treatment

Cool any burn for at least 20 minutes in or under cool running water as soon as possible. Even after a couple of hours it is still worth a prolonged period of cooling – long term it will reduce pain and speed healing. It is a balance, patients can develop hypothermia if you are not careful – but the cooling is important.

Keep in mind, rarely some chemicals, specifically, Hydrofluoric acid (HF) are very toxic, and water is not enough for irrigation. There is a specific andidote (calcium gluconate) to be applied, which should be immediately available before even starting treatment.

Remove any jewellery even if the burn is a further up the limb and away from the hands or feet – swelling on a burned limb can be extensive.

Severe burns (partial / full) > 40-50% in an austere environment will almost certainly be fatal. These patients require careful triage of resources to prevent excessive use on a lost cause. There are well documented cases of the successful management of serious burns below this threshold in the third world or austere environment, but resuscitation and care above this cut off is almost universally unsuccessful.

Patients with burns lose a lot of fluid through the burns and into the tissue surrounding the burns and often get dehydrated or even shocky. They need replacement fluids. Traditionally this has been intravenously. However, patients with burns up to 35-40% BSA can be successfully managed orally – which corresponds with survival from burns in an austere situation.

There are several formulas to calculate the volume required in the first 24 hrs one of the more common ones is the modified Parkland formula:

Volume in the first 24 hrs = 3mls/kg x % body surface area burnt
- 50% are given in the first 8 hrs
- 50% are given in the second 16 hours

After 24 hrs., the amount of fluids given should be adjusted to urine output and other signs of poor perfusion. How do we know if this is too much fluid, or too little?
- Aim for a urine output of at least 50 ml / hr.
- In the face of decreasing urine output = need for more fluids.
- A low blood pressure/signs of shock = need for more fluids

The risk of infection is primarily in the first 48 hrs to 1 week – watch for fevers (take temperatures – actively look for fevers) and signs of a smelly discharge from the burn. Fever and/or discharge = infection

Dressings:
There are many burns dressings available – the chance of having a meaningful selection in an austere environment is low, but it is important to understand what we are trying to do with burns dressings, which potentially can help with 'work arounds' and improvised dressings.

The goals are to:
- ❖ Protect the healing skin
- ❖ Absorb the fluid lost from burn
- ❖ Cover the wound and help prevent infection

Silver Sulphadiazine (SSD) cream:
SSD cream is almost ubiquitous in the management of partial thickness burns in an austere environment. It reduces infection and aids healing. It is not popular in modern burns center as it can colorize the wound permanently and makes assessment of the depth difficult. It is ideal for deep partial thickness burns. SSD cream is widely available as burn cream both in human and veterinary practice, and it is useful to stock if available for austere situations when treatment in a burns centre is not going to occur.

Potential austere dressings:
- Gauze. Standard gauze will absorb exudates and protect the burn, but will stick to burn and hurt a lot and cause damage when it is time to remove. It can be soaked off – but this may macerate the burnt skin and delay healing.
- Paraffin or Vaseline gauze is probably more useful as it will reduce the incidence of sticking the moisture will pass through it, so normal absorbent gauze can be placed over the top to absorb the exudate and will be less prone to sticking
- Glad-wrap/Cling-wrap is an excellent initial dressing to keep the wound covered and clean. It has no absorptive capacity and is only really an initial temporary dressing.

b. Medium to long-term care of burns

Partial thickness burns:
Partial thickness burns heal slowly, but most will heal well, provided they are kept clean and free from infection.

Infections:
Consider infections if there is increasing pain (after briefly getting better), fever or offensive smelling exudate.
The ideal antibiotics are Flucloxaxillin or Co-Trimoxazole

Contractures:
As scar tissue heals it tends to contract (shrinks). This is a problem over joints and hands and results in contractures. These can cause disfigurement and disability as joints are deformed and limbs shortened. There are severe strategies to reduce contractures in an austere environment:

- Deep partial thickness burns will benefit from the patient wearing a tight-fitting wetsuit material over the burn, especially over joints e.g. knee, elbows, hands and ankles. This aids healing and reduces contractures.
- Deep partial burns also require periods of gentle stretches 5-6 x per day for 6-12 months. This reduces contractures significantly.
- Efforts should be made to introduce normal functional activities as soon as possible

Nutrition:
These comments apply to both partial and full-thickness burns. As discussed above, the systemic reaction that occurs with severe burns consumes both calories and protein and places an enormous nutrition burden on the patient's body. Patients with burns up to 20% can generally be managed with eating and drinking in the normal fashion. For bigger burns > 20% burns some patients will not be able to ingest enough calories and protein by eating normally.

Full thickness burns:

Full thickness burns don't heal and require specific treatment to help minimize loss of function. Full thickness burns usually co-exists with areas of partial thickness burns. So, these areas need optimal treatment to reduce the incidence of infection or the development of skin contractures.

Current in-hospital treatment = extensive excision of the eschar and grafting and, if needed, extensive plastic surgery to create flaps of skin and fill in defects or loss of tissues. If left untreated the eschar will eventually slough off, leaving large areas of granulation tissue, but not skin.

- May scar and form contracture over joints
- Chronic pain
- Infection

There are limited options for the austere treatment of full thickness burns. If the area is small areas (<1-2cm2) – excise eschar and allow to heal by secondary intention – it will happen slowly but generally skin will slowly grow in from the edges. For medium sized areas (5-10% body surface area) split skin grafting is an option.
For larger areas on limbs – consider amputation – they will not heal, and there is considerable risk of significant disability to the point that amputation is generally preferable.

Skin grafting:
Split skin grafting in its most basic form is very simple and is easily done in an austere environment with minimal equipment. The concept involves shaving a section of epidermis and superficial dermis off an area of healthy skin and placing that shaved skin over the burnt area (or area of open damaged skin if a wound). Skin grafting can also be applied to any other skin injury where there has been loss of skin and the defect will not heal by itself (any would with >1-2cm2 surface area)

Prepare the area – clear the burnt area – remove any debris or scab or eschar (should have a pink surface which bleeds when touched).

- Equipment: Local anaesthesia (if available)/Skin antiseptic/Scalpel blade or an old fashioned adjustable razor
- Choose an area with no or minimal skin hair.
- Have an assistant hold the skin tight under tension.
- Use scalpel or razor blade shave top layer of skin off (should look like thick piece of tissue paper).
- It doesn't matter if it has the odd hole in it or is a little uneven.
  The skin underneath should look a bit like chicken skin and be bleeding.
- Spread the cut skin out – cut with a criss / cross pattern with a scalpel blade and spread out further.
- Lay it over the area of the debrided 3rd degree burn / or wound. It can be tacked down with sutures.
- Multiple grafts may be required and shouldn't overlap.
- Apply a non-adhesive dressing and firm pressure.
- Leave on for 5 days before inspecting – healthy graft will appear pink. Dead or dying graft will look black. Borderline viability graft will look congested. Often there will be a mix of healthy, borderline and dead tissue – provided the majority is healthy – re-bandage and inspect again in 72 hrs.

This is plastic surgery at its most basic form, but it does work in an austere environment.

C. Medical Conditions:

1. My son has asthma and we have don't have his inhaler.

Asthma is common disease of breathing. It is classically episodic, which means people are well between episodes. It affects all ages, but is probably at its worst between 5 -20 years. As people get older (50-60) they can develop chronic lung disease (like emphysema or chronic bronchitis), which can look like asthma but symptoms are usually present all the time.

Clinically we see patients who are short of breath, struggling to breath and making a wheezing noise – sometimes audible to the naked ear and sometimes only heard when listening to the chest with a stethoscope.

Asthma has three general features causing the clinical signs: the smooth muscle in the medium breathing tubes (bronchioles) becomes overgrown and narrows the diameter of the breathing tubes, this smooth muscle band can also go into spasm and the cells lining the breathing tubes produce extra mucus. The consequence is that the breathing tubes become narrowed and congested with mucus.

These changes account for how asthma presents discussed above:

Shortness of breath and sensation of struggling to get breaths - because of the breathing tubes are not letting enough air through.
A wheezing noise – caused by the turbulent flow of air through the narrowed areas.

Management:

The management is focused directly on treating the underlying problems:

Beta-agonists (salbutamol/albuterol) – reduces the spasm in the muscles and improves airflow. Works quickly over minutes

Steroids (Prednisone/Dexamethasone) – reduces the mucus production and the muscle overgrowth also increasing the diameter of the breathing tubes. Works over hours to days.

Austere treatment:

Prevention:

- Avoid triggers.
- Breathing exercises
- Caffeine – caffeine is from the family of xanthines. Theophylline is a drug from this family common used in preventing and treating asthma. There is no clear dose/response to using caffeine in the prevention or treatment of asthma, but there is a strong association between a cup of strong coffee (or cocoa – which also contains caffine) and a degree of bronchial relaxation – but there is a lot of variation between people.
- Magnesium can be used as an infusion if available.

Acute disease:

- Calm the patient down
- Inhale warm water vapor
- Salbutamol via a spacer if available or a short course of steroids if available

2. My wife has got a bad headache. What do I do?

The first problem with headaches (HA's) is that they can represent a life-threatening problem or they can simply reflect some mild heat stroke or a minor viral infection. Fortunately, the ratio of minor to serious is 200:1 – you will literally see dozens of patients with a minor cause for their headache for every patient with a serious cause.

The second problem is that it can be very difficult to tell the difference between the serious and the trivial. A severe headache from a non-serious cause can look the same as one from a life-threatening cause. Currently in hospital we use CT scans of the brain and an analysis of the fluid around the brain (CSF or spinal fluid) to help identify the serious causes. In an austere environment, you must identify potentially serious causes based on symptoms and signs.

Red Flags of Serious Headaches:

Think **SNOOP:**
Sudden onset headache – 'bang' it is there

Neurological signs or lowered conscious state
Onset different to normal (i.e. not their usual headache)
Older patients
Pattern: certain headaches have a harmless pain pattern, others have a sinister appearance.

Some basic patterns can help you narrow down the diagnosis

- Severe headache + fever = meningitis (remember most viral illness's will give a mild to moderate HA – we are talking severe HA here)
- Severe headache + fever + neurological signs = meningitis
- Altered conscious state (drowsy) + fever = meningitis
- Headache + neurological signs = bleeding inside the head
- Worsening headache over months + new neurological signs = brain tumor
- Bad headaches in the morning which get better over the day = brain tumor

Having identified a potentially serious cause what do you do? Unfortunately, not much unless your diagnosis is one of meningitis (infection) which is potentially treatable with antibiotics. They will either get better with simple care or they will likely continue to deteriorate and some will die or suffer from brain damage.

Treatment:

We suggest a universal approach to the management of headache:

1. Nurse in a quiet/darkened room: by reducing sensory input into a upset brain (reduced light, movement and sound) often reduces the degree of headache and can significantly reduce distress.
2. Bed rest: For similar reasons to 1 – resting the brain and making it not have to think much is good for headaches. In the same way, concentration or reading can worsen headaches. Relaxing the brain and taking away the need to think too hard can offer significant relief.
3. Simple analgesia: High dose aspirin (900-1200mg) is good choice if it's available but Acetaminophen (paracetamol or Tylenol) is also a good alternative.
4. Hydration: Some migraine headaches and any headache which is a consequence of dehydration (fevers, heat stroke, lack of fluid in) can be improved with the correction of hydration. Small frequent sips of a palatable fluid or intravenously if available.
5. Anti-emetic: A medication which helps stop nausea (commonly associated with bad headaches) can help improve the overall state of the patient. If you have a specific anti-emetic such as Ondansetron or Cyclizine then use those, but a sedating antihistamine such as Phenergan (promethazine) or Benadryl work well.

If you have identified a specific life threatening cause then manage symptoms as you can and apply the basic principles above.

3. What is a stroke? How do I deal with one post-SHTF?

A stroke occurs when the blood flow to part of the brain is blocked and brain cells dies. Depending what cells die or are damaged determines what clinical picture we see. Because of how the brain is wired, damaged on one side of the brain usually results in loss of function on the opposite side of the body.

There are a couple of terms you need to understand:

> **CVA** = Cerebrovascular accident = Stroke. Symptoms occur and are still present to some degree > 24 hours later.
>
> **TIA** = Transient ischemic attack = a resolved stroke. Symptoms consistent with having a stroke have occurred, but resolved completely in less than 24 hours.

There are two main stroke syndromes:

1. Hemispheric – presents with unilateral weakness +/- altered sensation (hemi-paresis) +/- speech problems / swallowing problems / understanding problems
2. Cerebellar – presents with problems of balance / co-ordination / speech

Identification of stroke is largely based on the clinical presentation. A useful screening test is the "FAST" test

Facial symmetry
Arm droop
Speech problems
(Time of onset) – useful with a working hospital but not really for our purposes.

The best approach to the treatment of stroke (like many things) is prevention – focus on maintaining good cardiovascular health.

Austere treatment is possible, and usually there is degree of recovery, but is largely based on guess work. Persistent disability can be marked and, in some patients, a stroke will be fatal. Initial care is supportive look after A, B and C – with attention paid to hydration, positioning and stretching (see Chapter 20 – nursing care). Extensive physiotherapy and occupational therapy may be required and both are labor intensive and time consuming (see Chapter 22 – Primitive Medicine)

Initial treatment is a small dose (300mg) aspirin.
Aspirin or Willow-bark tea daily may be useful in a prevention of recurrence.

4. My brother is a cripple after his stroke and is burden on the group. What should I do?

Decisions around what to do with a member of your group who now has limited ability to contribute to the groups productivity is potentially a huge challenge and an group decision based on many issues.

What is important to understand though is that even people with substantial handicaps can often contribute in very meaningful ways to a groups survival through allocation to simple jobs and tasks.

There are two books published by the Hesperian Foundation which address the issues of disability and caring for those with a disability in detail and offers potentially roles within a community.

Disabled Village Children
A Health Handbook for Women with Disabilities

All are available to purchase or download in pdf format from their website: http://hesperian.org/books-and-resources/

5. One of our group had bad chest pain and now it's mostly better. What do I do?

Chest pain is a common presenting complaint. The problem is trying to decide is the pain was/is serious or not is an absolute mine field. The trivial and the life threatening can look the same

First you need to put the pain into context

- Was the pain caused by trauma or not?
- Is the patient young or old?
- Are they male or female?
- What is the type of pain? (see descriptions below)
- Were there any other symptoms associated with the pain?
- Did the pain radiate? (Did it go down the patient's arm or through to their back?)

We think of chest pain as three broad types of pain – combined with the other aspects of the pain we can they develop a differential diagnosis for the pain and decide how concerned we are.

- Pleuritic pain: This is a sharp pain. It is often worse with inspiration – i.e. taking a breath. Some patients describe it like a "catch" of pain when they take a breath.

- Visceral pain: This type of pain is generally more diffuse across the chest, often a deep ache. Some patients describe it as a pressure. It is commonly associated with sweating, nausea or vomiting. Visceral pain is more likely to radiate to the neck, through to the back or down the patients arm.

- Musculoskeletal: This is pain which feels like a pulled muscle. It does have some similarities with pleuritic chest pain, but usually can be clearly associated with movement of the chest wall and deep inspiration. It is generally described as sharp and worse with movement.

By defining the type of pain and answering the contextual questions around the pain you can start to develop a differential diagnosis of the likely cause of the pain and decide how worried you are. As

discussed in the Assessment chapter, you will rarely be able to be exact in your diagnosis, the goal is to decide if you think the cause of the pain is serious or not and if any specific treatment is required.

Heart pain is discussed in the next question but some of the other causes of chest pain and their relative seriousness are discussed below.

Indigestion

Indigestion is very common; the problem is, it can look like heart pain and can be a challenge to tell apart. It is characterized by:

- Being related to meals.
- Precipitated by specific types of food – tomatoes, curries.
- Acid regurgitation into throat, especially if lying down.
- Burning retrosternal pain – often starting in the epigastrium and sensation of acid rising from the stomach up the esophagus.

Treatment: In an austere environment options are limited - avoid precipitating foods (oily, spicy, caffeine), weight loss of overweight and antacids if available. Elevating the head of the bed by as much as 30 degrees can also help.
Give smaller, more frequent meals, as opposed to large meals, especially before lying down.
Acid reducing medications are also useful and are available in most countries as over the counter medicines

- Cimetidine
- Ranitidine
- Omeprazole
- Bicarbonate of soda will reduce acid, but only for a short while.

Pneumothorax

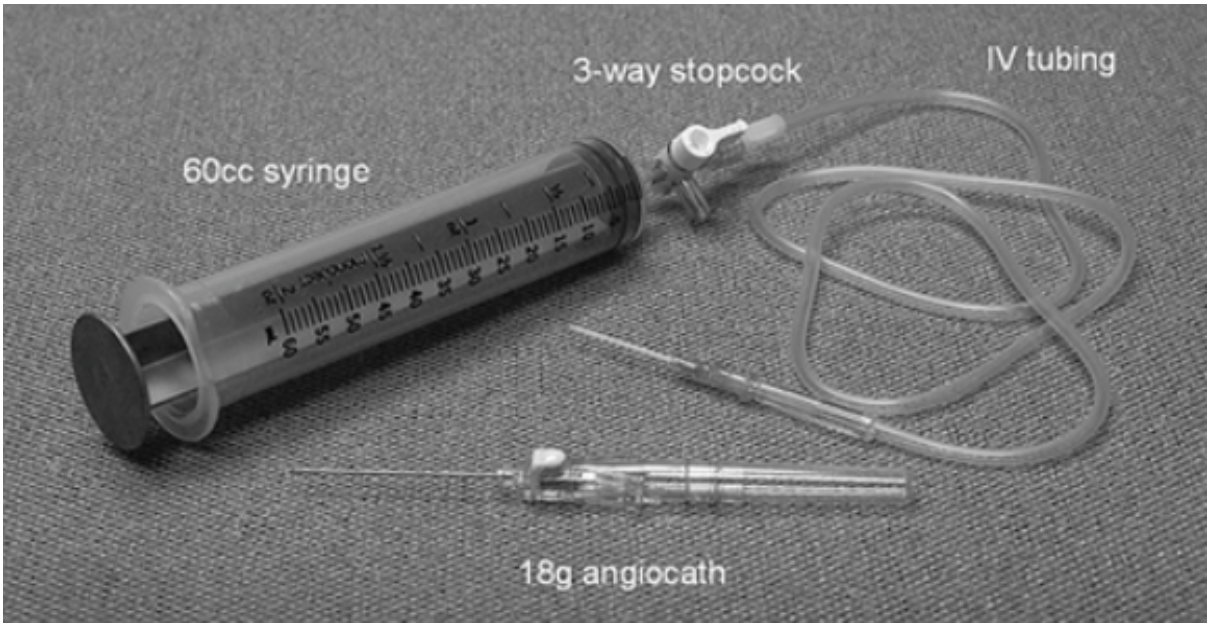
A pneumothorax is a collapsed lung. Normally a negative pressure in the chest keeps the lung inflated against the pleura inside the chest cavity. A pneumothorax occurs when that negative pressure is lost and the lung collapses. It can occur spontaneously (the lung develops a small hole and air leaks into the space between the lung and the pleura causing the lung to collapse) or due to trauma where a broken rib punctures a hole in the pleura.

Presentation is characterized by sudden onset, shortness of breath, and pleuritic chest pain – often associated with strenuous effort, but can occur spontaneously. Classically the clinical findings - increased respiratory rate, and reduced air entry on the affected side which is resonant to percussion

In an austere situation, the diagnosis is clinical - if the pneumothorax is large enough to cause symptoms then it is usually easily recognized.

Treatment: What you do depends on the severity of symptoms. In austere situation where you suspect a pneumothorax, the best option is to do nothing – this will work for ~90% (the definitive study is underway to define exactly the number). For the small number with persisting symptoms simple needle/syringe aspiration is probably the most useful technique.

Using a long needle, pass the needle through the second intercostal space/mid-clavicular line and aspirate air into a 50ml syringe, using a three-way tap, until you have removed 1-2 litres.



set up to aspirate a pneumothorax or fluid on the lung. Uncredited internet sourced photo.

Tension pneumothorax is discussed in the Emergency Care chapter.

Pulmonary Embolism (PE)

A PE is a blood clot which originates in leg veins and moves to the lungs. It can compromise the blood flow from the heart to the lungs if the emboli are big

Clinically, it causes pleuritic chest pain and shortness of breath or a sudden reduction in exercise tolerance. It may be proceeded by evidence of blood clots in a leg vein:

- Unilateral swollen leg
- Calf pain
- No history of injury
- Congested superficial veins on affected leg

Features may also include coughing up blood, a history of cancer, or a period of prolonged immobilization (bed rest/plaster-of-paris bandage) or a personal history of a previous DVT or PE

A big PE often causes sudden death – usually proceeded by severe shortness of breath.

Treatment: There is no practical austere treatment. Administer aspirin if available. Prevention of DVT is the best treatment. Avoid prolong bed rest – if required ensure 3-4 times daily passive leg movement and stretches.

Musculoskeletal Chest Pain

This arises from direct trauma (a blow or contusion) to a muscle or boney area or a strained muscle Musculoskeletal pain is seldom life threatening, but it can be confused with other more serious causes of pain. The only real risk area is when it involves the chest – not from the muscle pain but because of reluctance to take deep breaths the patient is at risk of developing chest infection due to inadequate clearance of secretions → Encourage deep breathing exercises (even though painful)

Treatment: The standard treatment for musculoskeletal injuries is rest. Not practical for chest wall → Need to breath! Good simple pain relief: non-steroidal anti-inflammatory drugs (NSAIDs) such as Ibuprofen provide excellent analgesia. Strapping/supporting chest tends not to help – but some people find it useful.

6. How do I recognize and treat a heart attack in an austere situation?

Prevention is better than a cure – good diet, weight loss, and exercise to prevent a heart attack is infinitely better than trying to treat a heart attack in an austere situation.

The diagnosis of a heart attack is based on three things: a history suggestive of a heart attack, specific changes on an EKG, and a rise in some chemicals in the blood specifically associated with damage to the heart muscle.

In an austere environment, it is likely you will have to make the diagnosis based on the history alone and will never be 100% certain of the diagnosis. Any medical text will provide details of the history and clinical features associated with a heart attack – but in summary:

Heart pain

Some other common causes of chest pain are discussed above. While without ECGs and specific bloods tests, it is hard to diagnose with absolute certainty

The best way to think about this is that the heart is pump.
It is powered by oxygen
If not enough oxygen gets to the heart, pain occurs.
The more activity (pressure and pulse) the more work required of the heart. So, more oxygen is required.
If there is any problem with blood supply, not enough oxygen → pain.

Heart disease = narrowing of blood vessels supplying the heart muscle.
Angina = chest pain with exertion (occasionally at rest – but usually part of a chronic process). Demand for oxygen exceeds supply.
Chest pain/prolonged angina pain at rest = Myocardial infarction/Heart attack

Treatment:
If based on this it appears likely the patient is suffering from a heart attack, treatment is relatively limited. Despite billions of dollars being spent on heart attack research over the last 30 years, the two biggest things, which reduce mortality and morbidity, are both simple and cheap. First is the early administration of aspirin (which stops platelets, in the blood from sticking to each other and makes the blood slightly thinner) and the second is recognition of lethal heart rhythms and early defibrillation over the first 24-48 hours after the heart attack.

It is simple to store aspirin and failing that a herbal preparation made of willow bark is easy to make. Some automated defibrillators (AED's) are now relatively cheap (<$500 USD) so potentially having access to one is realistic for many groups. This enables you to manage the potential lethal rhythms'. So, the management of an acute heart attack in austere environment is feasible.

Initially, treatment of pain with opiates is also useful if available.

If a patient who has been having chest pain collapses in front of you, a precordial thump (a firm – but not excessive – blow with a closed fist delivered to the lower third of the breast bone) may be useful and can sometimes reverse a lethal heart rhythm – it delivers the equivalent of 5-10 joules of energy to the heart – compared with 200-300 with a defibrillator.

The patient needs to rest for the first 48-72 hours to avoid putting the heart under any stress. But it is a balance – we know people of who take to their beds and just stay there for days at a time in this situation.

The most common lethal arrhythmias are ventricular fibrillation or ventricular tachycardia – this rhythm should be recognized by a simple AED and defibrillated. If a defibrillator is not available consider a pre-cordial thump – a firm blow to the chest with a closed fist – this generates a small delivery of energy to the heart and in some patients, if given immediately may successfully defibrillate the heart.

A wide range of medications and interventions are used during and after a heart attack to reduce the incidence of death and complications and these make a difference to survival, but early aspirin and recognizing and treating an abnormal heart rhythm early remain the biggest lifesavers. Information regarding these other treatments can be found in most of the major-medical references – but access to these is unlikely in an austere or major disaster environment. Fortunately, the biggest bang for the buck is in doing the basics well.

Long-term complications

While simple care like Aspirin, access to a defibrillator and avoiding prolonged bedrest substantially reduce the immediate death rate from MI, unfortunately they often cannot undo the damage which is done or limit the size of the dead area in the heart. The consequence is that while basic care may prevent deaths from heart attacks, the survivor may have substantially reduced exercise tolerance.

7. I have high blood pressure? What happens when I run out of medications?

Learning to take a blood- pressure reading is an important skill. It's useful in assessing patients from acute illness and injury, but also screening people to identify the presence of hypertension as a chronic disease.

What's abnormal blood pressure?

Systolic > 100+age
Diastolic > 90

There are two types of hypertension – primary and secondary. Primary (or essential) hypertension which occurs in the absence of another disease – it "just happens" to the patient, there is no identifiable causes, and this accounts for most hypertension. It is probably a combination of life-style and genetics. Secondary hypertension occurs as the consequence of another disease – high levels of thyroid hormones, adrenal gland tumors etc.

In an austere situation, we treat all hypertension as if it is essential hypertension.

In the absence of specific drug therapy:

Lose weight
Improved physical fitness
Reduce salt in the diet
Consider an agent which causes increased urine production (diuretic) like caffeine – in some people the extra loss of fluid will help lower the blood pressure. Cabbage also has a small diuretic effect and may be useful if taken daily.

8. Can our diet (or lack of it) cause disease?

Yes. They are generally due to insufficient calories, insufficient protein or an imbalance of micronutrients such as vitamins or minerals.

i. Malnutrition

Malnutrition is an imbalance between supply and demand. Every organ system is affected. It results in the impairment of physical growth, neurological development and poor immune function

Children are the most vulnerable in infancy and early childhood and it accounts for ½ of Pediatric deaths in the Third World, it is often deficiencies of micronutrients.

There are two types:

1. Global deficiency (Marasmus) - Inadequate calorie intake

2. Primary protein deficiency (Kwashiorkor) – there is adequate calories but inadequate protein intake. It is characterized by low weight and additionally edema – think children with distended belly's.

Clinically you see poor weight gain, slowing of linear growth and behavior changes (irritability/apathy/social withdrawal). The diagnosis is made based on a BMI < 15 and more than 2 standard deviations below the age-related weight. Arm circumference is a useful screening tool of malnutrition.

Physically you see decreased subcutaneous fat, leading to apparent thinness and sagging skin, peripheral edema – swelling of the limbs, angular stomatitis – inflammation of the angles of the mouth and a bulging abdomen – due to weak muscles of the abdominal wall, edema fluid in the abdominal cavity or liver enlargement.

The treatment is relatively simple – calories and the right mix of protein, carbs and fat. You need to aim for a min of 150 cal/kg/days with a mix of protein, carbohydrates and fats.

Arm circumference

Age	Normal (min)	Danger
1 month	9.0cm	6.7cm
3 months	10.6cm	8.0cm
6 months	11.5cm	8.6cm
9 months	12.2cm	9.2cm
1-5 yrs	14.0cm	12.5cm
8 yrs	18.4cm	14.7cm
11 yrs	20.4cm	18.6cm
14 yrs	23.2cm	18.6cm
Adults	26.0cm	22.0cm

ii. Scurvy

Scurvy is a simply a vitamin C deficiency - inadequate dietary amounts It has a truly long and interesting history and for anyone interested in medical history it is worth a Google search.
The deficiency of vitamin C results in impaired collagen synthesis.

Signs and symptoms include: loss of appetite, irritability, diarrhea, pain and tenderness in legs – especially the thighs, swelling of long bones, bleeding gums (often the first sign that is noticed), spontaneous hemorrhages – resulting in bruising of the skin or bleeding into the gut, tender swollen gums.

Treatment is relatively simple - Vitamin C. From supplements or from the diet. Food sources rich in vitamin C include the following: citrus fruits, berries, broccoli, cauliflower, cabbage, spinach, potatoes and tomatoes. The easiest solution is to store Vitamin C. Sadly Vitamin C breaks down relatively quickly so has limited value beyond its expiry date – although it does not break down into anything toxic so it is worth chancing expired Vitamin C.

Food should not be cooked in copper utensils, as this destroys the vitamin C.

iii. Beriberi

Beriberi is thiamine deficiency. The human body has stores for about 1 month. Deficiency can be dietary or due to alcohol abuse or loss from diarrhoea. WWII POWs fed a primarily rice diet describe developing beriberi as a result of insufficient dietary levels of thiamine. Classically it is described as wet or dry beriberi.

Dry beriberi has predominantly nervous system involvement and is uusually due to poor caloric intake and limited physical activity, It presents with peripheral neuropathy (loss of nerve function), limb pain, paraesthesia (pins and needles type sensation) and cramps It can also result in loss of brain function – known as Wernicke encephalopathy. This is characterised by vomiting, jerking eye movements, eye muscle paralysis, unsteady gait and mental impairment.

Wet beriberi has predominantly cardiovascular involvement. It is generally seen when there is a high caloric intake and significant physical activity but inadequate dietary thiamine. It has three clinical stages:

> Stage 1: Peripheral vasodilation leading to a high cardiac output response – increase in both stroke volume of the heart and heart rate.
> Stage 2: Salt and water retention occurs leading to peripheral oedema (water in interstitial space)
> Stage 3: Heart failure / Chest pain

Treatment: The optimal treatment is parental (injections of) thiamine if available (50mg IM) for several days). In an austere situation that is likely not to be possible, so dietary replacement is required - all vegetables and the outer layer of grains are high in Thiamine. Processed vegetables and grains have relatively low levels of thiamine.

iv. Rickets

Rickets is a deficiency of vitamin D metabolites. Vitamin D is synthesised in the skin from precursors by exposure to UV. If there is not enough exposure to UV light there will not be enough Vitamin D produced. This is potentially a problem is living underground for a prolonged period or when there are periods of low sunlight. Occasionally it can be due to a abnormality or deficiency of calcium metabolism.

It presents with thickened abnormal bone growth and weakness of the bones. It usually begins on the skull, with knobbly lumps. Knobbly ribs and long bones can occur. The long bones of the legs become weak which leads to bowing – a classically “horse riding” posture.

The treatment is Vitamin D supplementation. Fish oil is rich in vitamin D but is generally low in other foods. Exposure to UV light improving the metabolism of vitamin D can also help. The problem is that it is a very individual thing how long it takes to for lack of sunlight to become a problem. Generally more than 10-14 days then there is a potential to develop Vitamin D deficiency.

8. What will happen if I get cancer PSHTF?

The problem with cancer is that it covers a huge spectrum of disease. All a cancer is an abnormal growth of cells within the body. They can affect any organ system in the body. They can be hard to diagnose or easy. They can grow rapidly or very slowly. They are likely to be very problematic in an austere situation. It is likely only those that are visible will be easily diagnosed. Presentations will often be late, there will no ability to screen for cancers, when a cure is unlikely.

Some will be amenable to primitive surgical excision:

- Skin cancers
- Mouth/Tongue cancers
- Breast cancers – presenting on the surface of the breast or as a defined lump.
- Muscle and bone cancers on extremities –amputation.

It is likely to be diagnosed due to:

- Lumps in the skin
- Pressure on other structures due to size of tumor, causing obstruction and swelling
    - Bowel obstruction in bowel, liver and ovarian cancers
    - Obstruction of the drainage from liver with liver and bowel cancers → causing jaundice
    - Problems swallowing from esophageal cancers
    - Severe headaches with brain tumors
    - Bleeding from the tumor
        - Rectal bleeding from bowel cancers
        - Vaginal bleeding from endometrial, cervical or vaginal cancers
        - Coughing up blood from lung cancers and vomiting up blood from esophageal cancers.

Austere management is likely going to be limited to excision described above and simple supportive care such as pain relief and nutrition support. Most cancers will return to being terminal. There is potentially a role for euthanasia but that is beyond the scope of this book and highly dependent on personal beliefs.

D. Genitourinary problems:

1. What if I suspect a sexually transmitted infection (STI)?

There are lots of STIs, but there are two big ones which account for most infections.

Syphilis:

This is a bacterial sexually transmitted infection, caused by the bug Treponium pallidium.

Classic presentation is that of a painless penile ulcer (called a chancre) which comes on a couple of weeks after exposure and lasts for a couple of weeks and then goes away. For men 95% of the time it's on the penis, for women its often on the cervix or vaginal wall so isn't noticed. A lot of patients also have an enlarged lymph node in the groin.

It returns a few months later as a rash all over the body that looks likes small pus filled spots or small raised rashes (secondary syphilis). The rash is painless. Again lasts a few weeks and goes again.

If it remains untreated then you get tertiary syphilis (years later) which can affect the heart or the brain primarily – both are bad and eventually kill you. If it affects the heart, death is usually sudden due to a rupture of the aorta. If it affects the nervous system the patient will develop a type of dementia (memory loss and confusion) along with problems with balance.

The good news is that it is extremely sensitive to Penicillin. A single dose if IM is all that is required. A single dose of Azithroymcin dose also works.

Historical metallic mercury was used – basically it was a dangerous treatment that didn't work – it did make the skin lesions heal quicker – but it didn't treat the infection so you still got the complications. Arsenic was developed into a compound that did cure some people early last century – but that was trumped by Penicillin. There is no austere treatment except avoidance!!

We sadly know exactly what happens when it's not treated, there was a very unpleasant experiment the American government started on black American men in the 1930's

"By the end of the study in 1972, only 74 of the test subjects were alive. Twenty-eight of the original 399 men had died of syphilis, 100 were dead of related complications, 40 of their wives had been infected, and 19 of their children were born with congenital syphilis." (wiki)

From an austere perspective, the differential is quite narrow.

Painful small ulcer(s) = herpes
Painless medium sized ulcer = syphilis

The true differential is much broader but in a Western (i.e. non-third world) population this is a good start.

Gonorrhea/Chlamydia

Gonorrhea and Chlamydia are separate bacteria and cause separate disease. However, they co-exist so often that we usually talk about them together and if we cannot specifically do the test to identify the exact cause of a likely STI.

The risk factors for Gonorrhea/Chlamydia include:

Patient below 21 years old
Patient single
Patient has had sexual intercourse with more than one person in the last 3 months
Patient has had sexual intercourse with a new partner in the last 3 months

It can be hard to diagnose gonorrhea or chlamydia in woman. It should be considered in any sexually active (and they may not tell you) woman who presents with supra-pubic pain, low grade fevers or offensive vaginal discharge. In men, you may have complaints of painful urination and an offensive penile discharge. Unfortunately, many men and woman have minimal or no symptoms which can make the diagnosis hard and can result in further spread within a community.

In woman, it may progress to a more serious generalized pelvic infection – known as pelvic inflammatory disease.

Antibiotics are required. Give the following:

Amoxycillin 2g (4 tabs) stat AND
Probenecid 1g stat (delays the excretion of the penicillin) AND
Amoxycillin and clavulanic acid 2 tabs stat AND
Azithromycin 1g stat.

If Amoxycillin and clavulanic acid is not available, give an extra Amoxycillin 1g stat
If there is no azithromycin available, give:

Doxycycline 200mg stat,
then 100mg oral twice a day for another 9 days OR
Erythromycin 500mg oral for times a day for 10 days

There are a variety of different antibiotic cocktails around, this is just one utilizing common readily available antibiotics.

Women who present with offensive vaginal discharge in isolation and no risk factors for an STI (above) are more likely to have vaginal thrush or infection with bug called trichomonas which thrive in the environment of the vagina – it can be treated with a single dose of Tinidazole or a 5 day course of Metronidazole.

2. What is a urinary tract infection (UTI)? How is it different from a kidney infection?

UTIs are very common. Usually the bacteria colonize the bladder from the outside of the body – ascending the urethra to the bladder.

They are more common in woman than men by 20:1 – they are also more complicated when they occur in men due to the more complicated plumbing. In women, the urethra (the pipe from the bladder to the outside) is only 4-5cm long and straight. In men, the urethra is 12-13cm long and takes a convoluted

course. So, in men it is harder for bacteria to ascend to the bladder, but if they do they are harder to treat

Signs and symptoms:

- Fever
- Pain on urination
- Increased frequency of urination
- Lower abdominal pain/supra-pubic pain
- Cloudy, offensive smelling urine – poorly sensitive – let's face it, lots of urine smells bad!
- Blood in urine (not commonly visible to naked eye in most UTIs).

Older patients are more likely to present with less specific symptoms – like new onset unsteadiness or confusion and you should always think of a UTI if confronted with a confused older person.

The diagnosis is confirmed with a urine dip stix – these are discussed in Chapter 15 – Laboratory Medicine. What is classically detected in the urine is:

- Red blood cells
- White blood cells / leukocytes
- Nitrites
- Protein

Nitrites are the most specific for a bacterial urine infection and the presence pretty much assures the diagnosis.

Interpreting a urine dip-stix:

Protein only + no symptoms = probably normal
Protein only + symptoms = probably normal
Protein + blood = still could be anything – normal, women with her period, UTI (but unlikely) – likelihood increases with symptoms (Get her to insert tampon before giving urine sample). Could be kidney stones.
Protein + blood + leukocytes + symptoms = almost certainly a UTI.
Protein + blood + leukocytes + no symptoms = almost certainly a UTI.
Protein + blood + leukocytes + nitrites +/- symptoms = a UTI.

Treatment

Most important is a slight increased fluid intake. This results in an increased urine production and essentially helps to "wash" bacteria and debris out of the bladder.

Alkalization of the urine also helps clear an infection and makes urination less painful. Commercial preparations are available (e.g. Ural ©) but simple baking soda does the same thing and is a lot cheaper. Vitamin C tablets (sodium ascorbate, in the alkaline form) do a similar job.

In woman who appear well, conservative treatment should be tried first. If that fails or they are unwell (and all men with UTI's), then antibiotics are appropriate. Conservative treatment consists of drinking

more water and alkalinizing the urine, as described above. Cranberry juice if available has been found useful by some women.

Antibiotics: For most UTI's, a short course with 3 days of an antibiotic like Trimethoprim* or Norfloxcin (which kills the common bugs and are well concentrated in the urine) is all that is required. Males require a longer course (7-10 days) and females who are unwell may benefit from a broader spectrum antibiotic like Co-trimoxaole or Amox/Clavulanic for 5-7 days.

*Trimethoprim and co-trimoxazole are not to be used in pregnancy.

Pyelonephritis differs from a UTI in that the infection is ascending or is established in the kidneys. The bacteria have migrated from the bladder upward to the kidneys. The symptoms are like those of a UTI, but more severe (higher fevers, more pain) and often are also associated with back or flank pain and nausea or vomiting. The treatment (and antibiotics) are essentially the same as for a patient who is unwell with a UTI, but are required for 10-14 days. Consider intravenous antibiotics if the patient appears seriously unwell.

3. My patient tells me he has had kidney stones before, and has them now. He is really distressed. What is it?

Some people prone to developing small crystal stones in kidneys – it can be a combination of genetics and bad luck. Recurrent episodes of dehydration increase the risk. Small ones are washed out with the urine, large ones are at risk of starting to travel down ureter (the tube that connects the kidney to the bladder, this can cause severe pain.

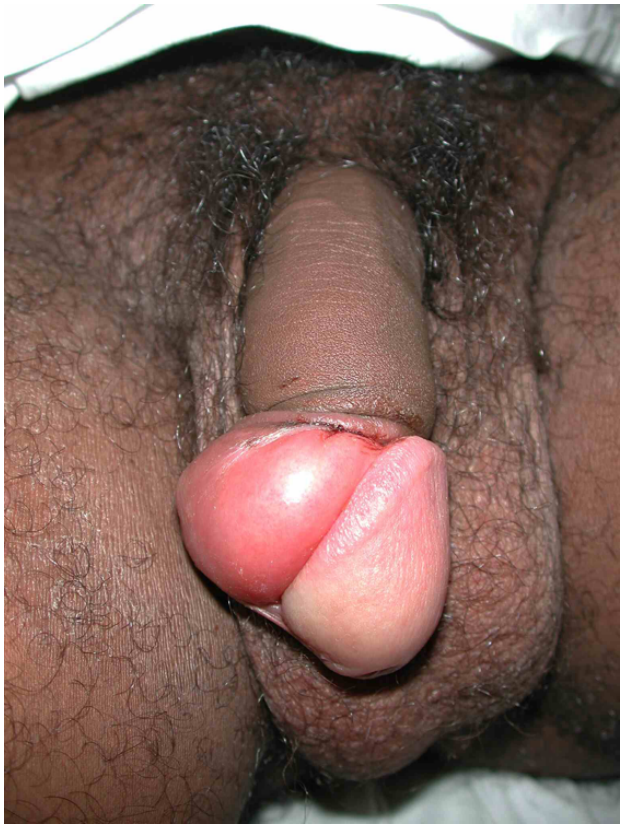
The classic presentation is colicky pain (that is pain which comes and goes in waves, and is minimal between waves). The patient is often writhing around the bed and unable to sit still. The pain usually starts in the loin on the effected side and, as the stone moves, the pain spreads around the patient's side radiating towards the groin. It may be associated with profuse sweating, nausea, and vomiting. The diagnosis is based on a classical story and blood in the urine – either obvious to the naked eye or only visible on urine test strips or under a microscope. The diagnosis can be confused in an older patient with a leaking aortic aneurysm – but as there is no austere treatment, it probably isn't worthy of consideration.

Treatment: Analgesia is the keystone of management – non-steroidal anti-inflammatory drugs are very good**.** The pain usually settles as the stone passes**.** Stones smaller than 5mm (which is most stones) will pass and just cause pain. Larger stones will not pass and eventually block the ureter and kidney. If this occurs there is nothing you can do and the kidney will probably be permanently damaged, although the pain will settle. However, if infection gets into the blocked kidney it can cause fatal infections.

4. A young man has come to see me with his foreskin stuck pulled back. Is there anything I can do?

A para-phimosis can only occur only in uncircumcised men and happens when the foreskin is pulled back over the glans (or head) of the penis quick enough, becomes a little swollen, and cannot be reduced, and the swelling gets worse and it get harder still to reduce the foreskin.

In an austere environment, the best approach is to put the head of the penis in cold water or pack it with snow. The cold will hopefully reduce the swelling and make reduction easier. After 10-15 mins of "cold" the swollen foreskin should be firmly held and squeezed around the circumference of the penis. This further reduces swelling – the foreskin should then be grasped and pulled forward over the glans. As an alternative (we know it sounds weird) pack the glans of the penis with icing sugar or corn flour – this pulls the water from the swollen area and makes reduction easier.



a para-phimosis

If this is unsuccessful and you have local anaesthetic available you can undertake a penile nerve block. The penile nerve supplies the glans of the penis runs down the top surface of the penis in the middle. You should inject 2-3 mls of lignocaine (lidocane) at the base of the penis where the top surface joins the body.

This should numb most but not all of the penis. When anaesthetised a scalpel can be used to the cut (not deeply – just 1-2mm deep) through the point of maximal constriction of the foreskin – it looks like a band.

5. My patient is a 14-year-old boy and has a painful testicle. What is going on?

It is likely to be one of two things:

Epididymitis – which is an infection in the epididymis attached to the testicle. If associated with a flu-like illness, with other swollen glands and particularly if both testicles are tender – consider mumps as a diagnosis.

Torsion – A torsion of the testicle occurs when the testicle swings on the blood vessels and tube connecting the testicle to the body. It cuts off its blood supply and is immediately painful.

It can be hard to differentiate between a torsion and an infection

- Torsion – patients are generally younger, not sexually active and usually unilateral
- Infection – patients are older, sexually active and it can be bilateral – although can still be unilateral.

Try lifting the testicle on the affected side, if this relieves the pain it is more likely to be epididymitis.

There is no real austere treatment for a torted testicle – the only possible option is trying to untwist it. Most of the time the testicle swings inwards, so untwisting the affected testicle by rotating it 180 degrees in an outwards direction (like opening a book) may work. If that doesn't work, the testicle will likely die. The vaguely good news is that once the testicle dies it will stop hurting and they rarely gets infected.

Epididymitis is often also characterized by painful urination or increased frequency. The patient may be systemically unwell – fever, nausea and/or vomiting. Urine dipstix may show blood and white cells or nothing. Try lifting the testis on the affected side: if this relieves the pain, it is probably epididymitis. Treatment is with antibiotics:

- Ciprofloxacin 500mg twice daily for 10 days
- Doxycycline 100mg twice daily for 10 days

E. Dermatology

1. There are so many rashes. How can I tell them apart?

It is often impossible even for experienced doctors to accurately diagnosis a rash. The main questions to are:

- Is it a rash by itself or part of another illness?

- Is the patient sick or not sick?
- Do I think its an infection?

An isolated rash in a well person and you don't think its an infection can be managed with masterful inactivity. The broad principles of rash management apply:

If it is wet – dry it/If it is dry – wet it

The best way to dry a rash is with exposure to sunlight and fresh air.

The best way to wet a rash is with the application a moisturizing cream such as 'fatty ointment' or "emollient base". Even simple non-perfumed moisturizing lotion is appropriate. Home-made moisturizing cream can be made from several everyday ingredients including bees wax mixed with olive oil.

Applying topical treatments under an occlusive dressing (cling film, or plastic glove), can increase the effectiveness, as well as side effects).

A good dermatological photo atlas can also be useful. These often provide a nice clinical summary along with numerous pictures and algorithms which allow you to approximate the correct diagnosis.

2. How do I approach a localized red rash?

As mentioned above, it can be hard to tell what is what when you are relatively inexperienced. Some general rules may help:

Rashes in groin or between toes or arm pits → think fungal

- Fungal infections are very common
- They like warm damp environments
- Treatment is with a topical anti-fungal → clotrimoxazole

Localised rash + itchy → allergic dermatitis / eczema

- Use an anti-histamine for itch
- Use a steroid cream (hydrocortisone) for the rash itself
- Moisturise skin, aim to keep it slightly oily (avoid long, hot showers or too much soap).

3. What is this all over red rash?

What the rash is isn't overly that important. There are several causes of wide spread red rashes. There is one important question – Is the patient unwell or not?

The "unwell" patient with a red rash:

Think of anaphylaxis. Does the person have any known allergies? Is it a flat rash or a raised urticarial rash – which is more consistent with anaphylaxis?

Think of infection. Does the patient have a fever? Rashes are very common with viral infections in both adults and children. In the absence of any other sinister symptoms (abnormal vital signs, altered conscious state) they are usually benign.

The "well" patient with a red rash:

If no clear cause (looks like sunburn or an allergic rash):

Antihistamines
Cool the skin – cool showers/bath
Avoid hot or sweaty clothes

4. What is this purple spotty rash? Now some are becoming bruises!

Beware a purple spotty rash. You need to determine if they blanch or not – that is when you depress the rash with your thumb for 5 seconds and quickly remove it - the center blanches and slow returns to its original color. If no blanching occurs the rash is said to be petechial or purpuric (a purpuric patch is a large or merged group of petechial). Recognizing this type of rash is important as it is a flag that the patient has a life-threatening infection – usually meningococcal septicemia (but sometimes pneumococcal or staphylococcal). Patients presenting with this type of rash need early antibiotics – simple penicillin is very good for meningococcal sepsis. While killing the bugs is important – supportive care like maintaining hydration and an open airway are very important too.

5. How can I tell when a rash is an infection?

An infection of the skin is known as cellulitis. It usually originated from minor skin trauma, but can occur spontaneously. Cellulitis most commonly occurs on the arms, legs and face – but can occur anywhere.

The onset is frequently rapid and is characterized by local pain, swelling, heat and redness, usually spreading out from a central area. Blisters can occur over the inflamed areas, which can take on a dark congested appearance.

It can look a lot like a localized allergic reaction or a reaction to a sting. In the absence of a history of a sting it is likely to be cellulitis. An area of spreading redness associated with a bite is usually a venom reaction from the bite or sting. However if the redness/pain doesn't occur for 24-48 hrs + after the bite, it is likely to infection

The patient may develop generalized fevers, chills and shakes or nausea or vomiting.

Treatment:
The main stay of treatment is rest and elevation. In patients with a good working immune system, this is frequently enough. You should mark out the area of redness to give you an idea if it is getting worse or better.

If patient is unwell with evidence of cellulitis, antibiotics are advised if available. The best agent to choose is one with good action against Staph and strep:

- Flucloxacillin 500mg PO or IV 1gm TDS for 5 days
- Cephalexin 500mg PO TDS for 5 days
- Erythromycin 500mg PO or IV 1gm TDS for 5 days
- Co-trimoxazole can also be used if the above do not work.

Necrotising fasciitis is a special case. This is a deeper infection into the layers under skin. It is characterized by rapidly spreading redness and is frequently associated with areas of necrosis (black/blue skin) and blistering. Gas gangrene is subtype of necrotising fascitis but usually is slower spreading and caused by different organisms. The only effective treatment for both is early amputation.

6. There is scabies going around. Is this scabies?

The scabies mite is small lice like insect which burrows into the skin.
It is more common in poverty and overcrowding so is likely to be widespread in an austere or survival situation.

It is very contagious. It is characterized by severe itch which is worse at night.

Diagnosis of scabies can be a challenge, in terms of distinguishing any other type of rash.

What causes the irritation is the scabies mite, burrowing into the skin. Classically it is slightly raised itchy greyish rash, irregular, 0.5-1.5 linear burrows in the web spaces between the fingers, on the palms and wrists. They may also be found on or in elbows, nipples, armpits, buttocks, penis, insteps and heels. Around these burrows is often a red allergic looking rash which occurs as an allergic response to the scabies mite – it is usually a red erythematous rash, but may have small blisters, especially on the palm.

Using a handheld magnifying glass can sometimes help with the diagnosis as the actual burrows can be visualized and at times the mite visualized at the entrance to the burrow.

Treatment:
Ideally chemical treatment is the gold standard:

5% permethrin cream, left on the entire skin for 8–10 hours.
Gamma benzene hexachloride cream may be applied – but should only be tried once due to the risk of toxicity.
If available, oral Ivermectin 200 mcg/kg as a single treatment can be useful.

In the absence of a specific chemical treatment, rosemary oil or tea tree oil can be used to smother and kill the scabies mites. A low tech treatment which has some success is kerosene mixed with Vaseline to make an ointment which is applied all over.

All the household's linen and clothing should be hot washed at the same time, otherwise it can act as a reservoir for further infection.

classical scabies rash. Credit. Dermnet NZ

F. Gastroenteritis, Dehydration, Shock, Poor Perfusion and Fluids:

1. Can I drink from the river?

Gastroenteritis associated with drinking dirty drinking water is still one of biggest killers in the Third World, especially among children and the infirm.

It seems a simple concept: "don't drink from water sources whom people or mammals have poo'ed into". Yet time and time again people all around the world break it and suffer consequently.

For some of these people it is because of lack of knowledge and education, however some know the dangers and still take water from dangerous sources. So, the question "why" needs to be asked? The answer is multi-factorial, but simply put, if you have to expend all the calories you consume every day to supply you and your family with shelter, warmth, food, and water, you take short-cuts. To obtain water, clean it appropriately and store it so it remains clean is a time (and energy) consuming task. Not cleaning your water properly or not going as far to a safe water source may save you valuable time and energy. You gamble that nothing bad will happen to you or your family from drinking the closer water supply also

used by for bathing and watering stock. 99 percent of the time the gamble works, but the 1 percent it doesn't result in several family members dying from preventable gastroenteritis. It's an easy mistake to make when you are busy and stressed, but it can be deadly. All (even apparently clean) water needs to be disinfected, boiled or filtered prior to drinking, doing your teeth or being used in food preparation. At times, you will have "secure" water source, but even then, you can never be 100% sure of how clean it is and using unboiled or filtered is still a degree of risk

Even using apparently clean water in isolated areas is still a risk. Many native animal populations are infected with the parasite giardia lambia. Their poo finds its way into water courses and contaminates them with the parasite. By drinking the water, you become part of the life cycle of the giardia parasite.

In an isolated area, it is reasonable to use clean water for bathing and showering, however you should be careful to keep your mouth closed and not use it for teeth cleaning.

2. Why is diarrhoea important?

Diarrheal disease remains the leading cause of death in Third World countries, despite all the advancements we have made. In the aftermath of natural disasters which lead to the breakdown of water supply and sewage removal, it quickly becomes a problem again (remember the cholera outbreak in Haiti?). Diarrhoea happens because the intestines either stop absorbing water, or start secreting it. This is usually a result of a bacteria, virus or parasite that infects the intestinal cells. The fluid that is lost in diarrhoea is not only water but also electrolytes such as sodium and potassium that are very important for the rest of the body to have.

Diarrhoea is spread from one person to another through the poo of an affected person. If you have diarrhoea, you must be careful to wash your hands very well after defecating to avoid spreading it to another person. Likewise, if you care for a person sick with diarrhoea, wash your hands well and do not touch your face, eyes or mouth.

What kills is not having the diarrhoea or the vomiting, but dehydration. You must understand how to recognise dehydration and know how to treat it. The basis of any treatment is replacement of lost fluids and electrolytes.

Encouraging the patient to drink replacement fluid orally is usually the best approach both practically and physiologically. Several studies have compared the use of IV fluid rehydration vs. oral rehydration in children who were moderately dehydrated with gastroenteritis. They have found that an oral solution was just as effective as IV therapy in managing these children.

How much replacement which is required is relatively simple – the same must go in as comes out. If you're going to get fancy about it you should probably add an additional 10% to allow for losses of fluids you cannot easily measure such as with sweating or breathing.

Urine output can be measured and there are several figures which give a rough (and conflicting!) guide to how much is enough. For most people, urine output ought to be approximately:

At least 500ml per day (adults)
At least 30ml per hour (adults)
0.5-1 ml per kilo per hour for adults (double this initially in burns).
1-2ml/kg/hour for children.

It is often difficult to get a patient to drink, especially when they feel very unwell, but it must be emphasised to them that if they don't drink they will die. The secret is small amounts of fluid frequently. 10-20mls (1tsp) every 2-4 minutes over an hour. If you try and force a large volume down (even 100mls – 1/2 cup) down it will come straight up right away.

If it is only mild dehydration then what fluid they receive is not particularly important – water, juice, soft drinks* – as the body will absorb the fluid and sort out the electrolytes. However, if the dehydration is more severe then balanced electrolyte solution is a more appropriate option. The exact composition of this fluid isn't only important just that it must contain not only water, but also sodium (table salt), potassium (light salt – if possible but not vital), and some form of sugar. The sugar is vital for absorption to take place in the intestines; salts alone are poorly absorbed when the gut lining is damaged as it often is in gastroenteritis.

*Be careful using soft drinks, as the sugar content can worsen the dehydration. Do NOT use undiluted soft drinks to treat dehydration.

The following is an easy formula for making an oral rehydration fluid:

1/4 tsp Salt (Sodium Chloride)
1/4 tsp Lite Salt (Potassium Chloride)
1/4 tsp Baking Soda
2 1/2 Tbs Sugar

Combine ingredients and dissolve in 1000 mls (1 liter) of boiled and cooled water.

The other opportunity to break the gastroenteritis cycle is to make sure you wash your hands after defecation, before any food preparation – handling or cooking and before dealing with the sick or infants and babies.

It cannot be overemphasized that hand washing and clean drinking water will prevent 99% of diarrheal diseases. Wash your hands after defecation, before and after dealing with the sick or infants and babies, and always before any food preparation, whether cooking or handling. These simple measures go a long way in preventing the spread of this deadly disease.

Hand washing and clean water will prevent 99% of diarrheal disease.

3. Types of gastro.

There are several different classes of infective diarrhoea while most are viral and while similar in the treatment they require, there are several important bacterial ones to be aware of:

Vibrio Cholera
Is a very common cause of diarrhea in any large group of people with poor sanitation. It is characterized by a profuse watery diarrhea. There is active secretion of water and it leads to severe rapid onset of dehydration. Ten to twelve liters of diarrhea a day can be lost. Death is from dehydration

Treatment is aimed at avoiding life threatening dehydration. Treatment is with rehydration formula. More need to go in than out → 10L out, then 12L in. If available, then antibiotics are appropriate – consider Cipro, Doxycycline or Co-trimoxazole.

Salmonella (or typhoid)
It is a surprisingly common cause of diarrheal illness. Most infections in an austere setting are caught from either another affected person, but you can also acquire Salmonella from undercooked food, raw eggs, unpasteurized milk or fresh fruits & vegetables. For the majority, it is nothing more than a simple dose of crampy abdominal pain and diarrhea. From exposure to onset of symptoms is 2-7 days and it is characterized by diarrhea, abdominal pain, loss of appetite, occasionally fever. Usually no treatment is required, but if the patient is unwell then Ciprofloxacin or Doxycycline would be first choices

Campylobacter
Campylobacter is another common cause of diarrhea. Campylobacter is a common contaminant of store-bought chicken and can sometimes be also found in raw milk and eggs. As with most diarrheal diseases, though, it can be spread from person to person. From, exposure to infection can be up to 10 days.

It is characterized by diarrhea, abdominal pain, loss of appetite and occasionally blood in feces. Again, usually no treatment is required, but if unwell then Ciprofloxacin or Doxy would be first choices.

And yet again, this deserves mentioning— WASH YOUR HANDS!!! With soap and clean water, frequently if you are caring for others or preparing food. This is the single best way to prevent the spread of diarrheal disease in a community. Don't forget to add hand soap, in whatever form, to your list of necessary supplies

Anyone affected with gastroenteritis should not handle food for others until fully recovered.

4. When should I use antibiotics in patients with diarrhea?

Antibiotics are used way too frequently is patients with presumed infectious diarrhea or gastroenteritis – doctors in North America are some of the worst culprits.

The antibiotics of choice for infective diarrhea are Ciprofloxacin 500mg BD (twice a day) for 5 days or Doxycycline 100mg BD for 5 days

Antibiotics should one be used only if:

- Seriously unwell
- Persistent high temperatures associated with diarrhea over several days
- Large amounts of blood in with the stool
- If you think giardia / entamoeba → Metronidazole/Tinidiazole
  (Persistent diarrhea, bloating, not unwell)

5. When should I use anti-diarrhea medicine?

There are two different types of anti-diarrheal medicine.

First is a motility slower (i.e. it slows the movement of the gut contents) – Loperamide is an example of this. Loperamide will reduce the frequency of bowel movement, but it will not shorten the duration of the illness.

Second is a binding agent (i.e. it makes the liquid feces into a thicker solution) - Bismuth subsalicylate (Pepto-Bismol). Again this will thicken the bowel movements, but like Loperamide it will not shorten the duration of the illness.

6. Is there a specific treatment for Giardia?

Yes. There are two common drugs. Metronidazole (400mg TDS for 7 days) or Tinidazole (500mg single dose). Both are very effective at clearing giardia infection. Metronidazole is more effective, but tinidazole is easier to take as a short course.

If a specific antibiotic isn't available Giardia will usually clear eventually, but it may take many months and some will become significantly unwell during that time.

It can be difficult to clearly differentiate Giardia vs. another virus or bacteria causing the diarrhea. Generally conservative treatment for 7-10 days in the absence of improvement, especially if watery explosive diarrhea, with lots of gas – consider Giardia. The gold standard is identification of the parasite under the microscope.

Avoidance of infection in the first place is the best option – water should be filtered or boiled or both where-ever possible.

7. How do I decide whom to give fluid resuscitation to?

Perfusion. In a single word.

Perfusion is discussed in the Assessment chapter in more detail. Perfusion is clinical evidence that blood (and oxygen) is being delivered to the cells of the body. There are several ways we can assess for good perfusion:

- Blood pressure > 100 systolic.
- Strong radial pulse
- Warm peripheries

- Dry skin
- Good color
- Conscious state – awake, orientated and appropriate.
- Good urine production

With poor perfusion, we see the reverse.

We classify shock in three broad stages → mild / moderate / severe

Mild: The patient feels thirsty, mouth feels dry, headache, dark urine. This is seen in 5-10% loss of volume from bleeding or fluid loss or redistribution.

Moderate: above plus reduced urine output, increased heart rate, muscle cramps, reduced capillary refill time (3-4 seconds), skin tenting. This is seen with 10-15% volume loss.

Severe: above plus signs of poor perfusion/shock. Rapid heart rate, rapid respiratory rate, low blood pressure, significantly delayed capillary refill time (>4-5 seconds), confusion. This is seen with >15-20% loss. Clinically you can check for signs of blood loss by hyperextend the patients fingers and looking at the palmar creases. If they turn white, then their haematocrit is 30% or less – which suggests acute blood loss (although it is seen in chronic anaemia at times).

Patients who lose greater than this amount will have the above features but may also increasingly confused or unresponsive and it may not be possible to feel a radial pulse or obtain a blood pressure. When those findings are present it is prodrome to death.Patients who have signs of poor perfusion need fluid resuscitation. Most patients with only a mild to moderate degrees of impairment can be safely and successfully resuscitated with oral rehydration fluid – discussed above.

Patients who are too unwell to swallow need to have the fluid given by a different route.

Traditionally this has been intravenously. But this requires a sterile fluid, sterile administrating equipment, sterile intravenous fluid and the ability to cannulate a vein to administer the fluid into. Access to intravenous fluids is likely to be limited or unavailable.

8. How do we classify the causes of poor perfusion?

We see poor perfusion (or shock) in several circumstances. A good way to consider this is which part of the pump (the heart) and pipes (the blood vessels) - to use a plumbing analogy - are broken:

> Hypovolemic shock – the pipes are leaking. In this case, the blood is lost – either through internal or external bleeding, or due to loss of fluid due to dehydration or from burns. The treatment is aimed at stopping the leak and replacing fluid.
>
> Cardiogenic shock – the pump is broken. The blood is in the right place, but the pump is unable to pump a sufficient volume for the body's needs due to damage, such as after a big heart attack. The treatment is limiting fluids and trying to keep the patient as relaxed as possible

taking work off the heart. Sometimes medications are used to improve the efficiency of the pump.

Distributive shock – the pipes are broken and leak or they are too big for the circuit. In this case, the blood is there but fluid leaks out of the blood into the surrounding tissues or the pipes get bigger and fluid pools there and isn't available for pumping. We see dilated and leaky pipes in septic shock and in anaphylaxis due to allergy. Treatment is giving volume to replace leaky fluid and using a drug (usually epinephrine / adrenaline) to stop the leaks and make the blood vessels contract.

Obstructive shock – something is obstructing the pump. This is relatively uncommon in austere environments and example would be a big clot blocking the blood flow to the lungs in a pig pulmonary embolism. Treatment is usually front loading the pump by giving small amounts of IV fluids to help the pass the obstruction.

Neurogenic shock – the pipes are two big for the circuit. In this case, damaged nerve supply to the blood vessels has case them to dilate and blood to pool in them – dropping BP. Treatment is usually time and the blood pressure will rebound. If very low it can be supported with small amounts of fluid or epinephrine.

The different types of shock can co-exist at the same time but usually one will predominate.

9. Can I give resuscitation fluid rectally?

Yes. The standard technique of giving fluids to an unconscious, shocked, or dehydrated person is with intravenous fluids. However, this may not be possible in a survival situation. An acceptable alternative is to give fluids rectally. This method will obviously not work if the cause of the problem is severe diarrhoea because the intestines are unable to absorb the fluid.

Obviously commercially manufactured normal saline is the fluid of choice however the rectum is relatively tolerant to non-sterile fluids and home-made 'clean' normal saline, oral rehydration fluid or even clean water.

The person is placed on their side, with the buttocks raised on two pillows. A lubricated plastic tube with a blunt end (a large urinary catheter or nasogastric tube is ideal) should be passed through the anus into the rectum for about 9 inches. It should pass with minimal pressure and should not be forced. The danger is perforating the bowel. Once the tube is in place, it should be taped to the skin. A longer length of tubing and a drip bag or funnel should be attached to the end and elevated. Then 250ml of fluid slowly dripped in over 45-60 minutes. The catheter should then be clamped. This can be repeated every 2-3 hours with a further 250 ml. Up to 1250-1500 ml/24hrs can usually be administered this way. If there is over flow – i.e. fluid runs back out of the rectum - the volume should be reduced. A rectum full of faeces does not absorb water very well, so the amounts may need to be reduced, but given more frequently.

10. Can I give resuscitation fluid subcutaneously?

Yes. It's an easy and reliable way of delivering fluid to shocked or dehydrated patients.

Subcutaneous (SC) fluids involve placing a small cannula under the skin (not deep into muscle – just into the layer under the skin) and slowly administering the sterile fluid into that space where it is absorbed into the circulation. One of the values of this router of administration is that the fluid does not need to be as "sterile" as when it is administered intravenously. While in theory sterile is sterile – a sterile solution you make in your kitchen is not going to meet the same standards as that made in a commercial factory – so if you are resuscitating with homemade normal saline this is probably a safer route – with the absorption process acting to partially filter the fluid.

The sub-cutaneous space can be very tight and this restricts where the fluid can be given. It works best when given into areas where the space is more lax – like the abdominal wall or between the shoulder blades. The older the person is the more laxity there usually is in the SC space. The limiting factor is like giving fluids rectally is that it must be given relatively slowly, limiting the volume that can be given over 24 hours to 1000-1500 per site. Rates of 1ml/min per site are usually tolerated. Although there is no reason you couldn't give twice that amount by using two sites.

There is a risk of causing an abscess or infection under the skin using this method; however, if your patient is at risk of dying from dehydration, the benefits will outweigh the risk. You must not use the oral rehydration solution in this situation, only sterile saline or homemade saline. See Chapter 22 for instructions on making saline solution
Within veterinary medicine, it is common practice to use several different sites simultaneously to increase the volume of fluid that can be given in a short period of time to treat shock and dehydration quicker. This is not common practice in human medicine, but there is no reason this is unsafe and is a reasonable strategy if intravenous access is not available.

11. You have covered rectal and SC fluids. Why haven't you talked about Intravenous fluids?

Fluid therapy and balance is complicated. As lined above Intravenous fluids are over-rated in an austere situation. It is generally safer and just as effective to give oral, rectal or subcutaneous fluid.

However, when rapid or very large volume therapy is required the intravenous route is preferred if possible. What follows is a broad outline of inserting an IV cannula and administering fluid. Like many of the procedures discussed here it is a good description but should be supported by proper teaching and the opportunity to practice.

Practice, practice, practice! IV lines are easy to place and are not complicated, but you need to learn how to do it in the first place, and practice occasionally. It is a safe procedure and unlikely

to cause any serious damage – but nothing is 100% safe and the people you practice on should be aware of the very small risks of serious infection or nerve injury.

Giving IV fluids: Step One: Establish an IV line.

Usually the forearm or back of the hand is chosen to insert an IV. There are many veins visible under the skin, and if you can see a big vein it can usually be cannulated.

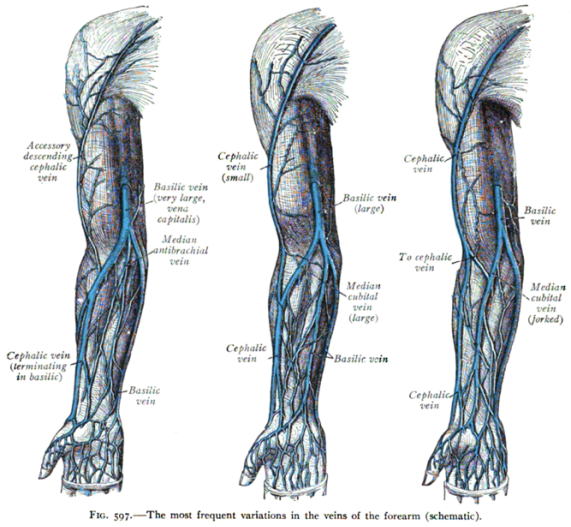


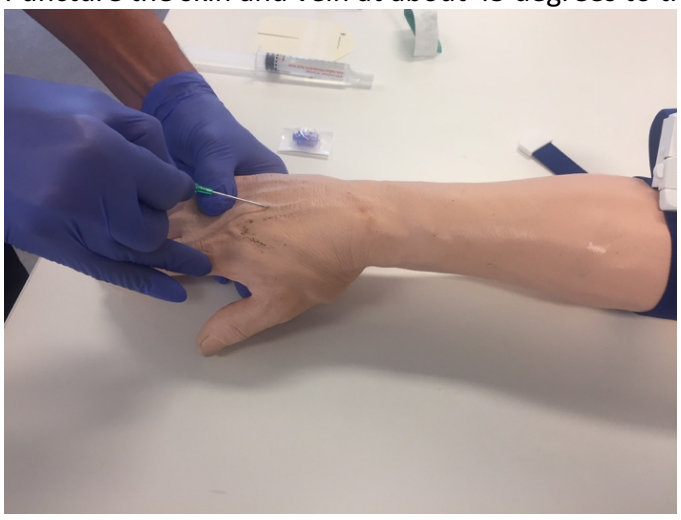
FIG. 597.—The most frequent variations in the veins of the forearm (schematic).

veins of the forearm (wikicommons)

Apply a tourniquet around the forearm – this congests the veins and makes them easier to cannulate. Look and feel for a vein. Tapping a vein with your finger or asking the people to open or close their fist can sometimes make the vein more prominent.

Clean the area over the vein with an alcohol swab or a clean water. Open the IV cannula and remove the needle cover.

Puncture the skin and vein at about 45 degrees to the skin.



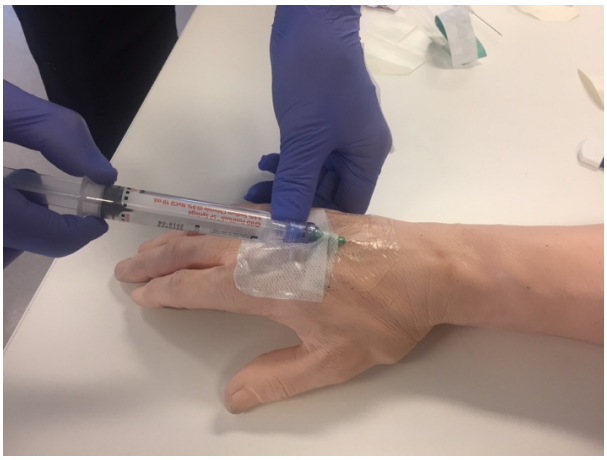
Gently advance the needle until you see a flash back of blood into the needle base.

As soon as you are happy you are in the vein slide the cannula off the needle into the vein as far as possible.

Remove the needle and cap the cannula. Secure with tape to ensure it will not fall out.

Release the tourniquet

Flush with a small amount of normal saline to clear any blood from the cannula.



The cannula is now ready to be used.

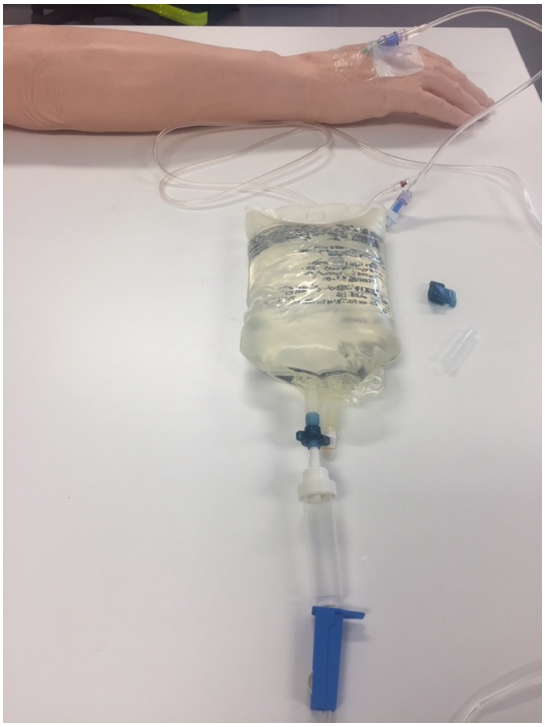
The cannula should not be left for more than 3-4 days. If the area around it becomes red, hot, swollen or sore it should be removed. If signs of infection are present it should be treated as you would a cellulitis.

Step Two: Set up an IV infusion bag

First choose your fluid.
There are many types of fluid around most common are Normal saline, Plasmalyte or Hartmanns (Lactated Ringers) solution. In an austere situation, any of these three are appropriate to use. They are also frequently labelled with the term – Isotonic – which means they are of similar composition to blood. **Avoid** any fluid which is labelled as 'hypertonic' or 'hypotonic' – these may do more harm than good.

Intravenous fluids are not simply sterile water. If you take tap water, boil it and infuse into somebody you will kill them. Any fluid you give needs to have a similar balance of positive and negative electrolyte ions to human blood. If it has, too few ions (hypotonic) it will cause excess fluid to move into the body and red blood cells to pop. If it had too many ions (hypertonic) it will drag fluid into the blood stream and dehydrate the rest of the body.
What you need is an isotonic solution – one that doesn't cause large fluid shifts in either direction. The way to achieve this is to use commercial solutions or to have a very exact recipe to produce your own IV fluids.

Fluid balance is complicated and giving the wrong fluid is potentially very dangerous. You must stick with isotonic fluid – preferable one of the three types described above.
Then you need a "giving set" to connect the fluid to the patient – this consists of a length of plastic tubing with a "spike" and drip chamber at the IV bag end, a mating connection at the other which connects to the IV. Along its length are several clamps to control flow.



Intravenous fluid usually comes in a plastic bag in volumes of 500mls or 1000mls. Usually the bag is within a heavy-duty plastic bag which must be removed to access the inner bag.
There is a special port at one end of the bag to attach the plastic giving set which connects the bag to the patient. "Spike" the giving set into the IV bag and let the fluid run through the line to expel all the air.

The bag needs to be hung approximately 1m above the patient.

12. How much fluid do I give?

You need to administer enough to improve their perfusion:

- Low blood pressure comes up.
- Fast heart rate comes down.
- Capillary refill time gets shorter.
- Conscious state improves.

Broadly, if the patient is unconscious and not eating or drinking, they will need a baseline of 2-3 liters of fluid a day, depending on temperature and amount of sweating.

Understand that giving IV fluid is not a panacea and giving to much or the wrong type can cause problems with fluid overload, dangerous changes to the chemistry of the blood and dilution of the clotting factors normally found in the blood.

Like so much in this book knowing the right amount and right type of fluid to give can be a clinical challenge and it not easy. First do no harm.

G. Surgical Problems and Wounds

1. Can I use Superglue to close a wound?

Yes and No. Superglue will effectively close wounds – with the same provisos as medical tissue adhesives (see Chapter 11). However, Superglue is not sterile (likely to have little impact) and different brands have different preservatives which may be harmful to injured tissue. It is likely to be no problem for small wounds, but there is a potential for toxicity when large amounts are used.

2. How do I use maggots to clean a wound?

Maggot therapy is now firmly established, especially in chronic ulcers. Maggot therapy for the treatment of wounds is also called maggot debridement therapy (MDT), larval therapy, and biotherapy. Modern maggot therapy is generally considered to have been pioneered by Dr W.S. Baer in the 1930's.

Dr Baer discovered the hard way that it is advisable to use sterile maggots – he suffered a 75% mortality rate on one occasion when using non-sterile maggots. Fortunately, sterile maggots are easy to produce – you start with eggs, immerse them in a dilute antiseptic, then raise the maggots on sterile food, their eggs should produce sterile maggots. A variety of materials are used in the initial sterilization – please consult the references for details.

The survival variation of maggot therapy is well described in the Primitive Medicine section of the US Special Forces Medical Handbook. This method skips the sterilization step. However, if you have any choice whatsoever do not, repeat do not, use non-sterile maggots. The odds of developing something like tetanus from using non-sterile maggots are not in your favor.

The sterile larvae are introduced into the wound. Dr. Baer used a significant number in his treatment of chronic osteomyelitis, sometimes up to several hundred. Modern recommendations are to use a maximum of 10 larvae /cm2 wound area; fewer should be used if little necrotic tissue is present (5-8 are more common). The wound is covered with a gauze dressing, taped to prevent possible escape of the larvae. After 1-3 days, the larvae are washed out of the wound by rinsing with sterile saline or water; more larvae are introduced if needed until the wound is clean (the period is based on how long it takes the larvae to turn into flies – it is desirable to remove them before this occurs). All maggots are not equal – some will eat living tissue. You should select larva, which only eat dead tissue if possible. The larvae of the following species are recognized are being useful:

Lucilia illustris
Phaenicia sericata (green blow fly)
Phaenicia regina (black blow fly)

References

1. Primitive Medicine in ST-31-91B US Army Special Forces Medical Handbook. Sept 1982
2. Baer, W.S. "The treatment of chronic osteomyelitis with the maggot" Journal of Bone and Joint Surgery. 13:438, 1931.
3. Pechter, E.A. "Maggot therapy: The medical metamorphosis" Plastic and Reconstructive Surgery. 72(4); 567-70. 1983
4. Sherman, R.A. "Low cost, low maintenance rearing of maggots in hospitals, clinics, and schools" Journal of the American Society of Tropical Medicine and Hygiene. 54(1):38-41. 1996

(S Roberts 1/04, Personal communication)

3. Can I use sugar to treat an infected wound?

Sugar therapy involves packing the wound with granulated sugar, ensuring that the entire wound is full. Surface wounds (abrasions etc.) can be treated with a dressing which has had a sugar paste applied to the side which will face the wound. The paste on the dressing should be thick – about a cm (3/8"). The wound is inspected, and when the sugar is syrupy with exudate the wound should be washed out, and fresh sugar applied. (Note that dilute sugar solutions can support rather than hinder bacterial growth.) Replacement of the sugar will ordinarily be required 1-4 times a day depending on the nature of the wound.

Sugar therapy should not be used on fresh wounds as it may cause additional bleeding; rather sugar therapy should be begun 1-3 days after the wound was inflicted.

Mixtures of granulated table sugar with povidone may also be useful (just add enough povidone to "wet" the sugar, not make a syrup) and is easily prepared by mixing the components; prepared mixtures of sugar and povidone iodine are commercially available. Adding oil of cloves in small quantities (0.4%) to sugar may also produce some useful effects.

(S Roberts 1/04, Personal Communication)

4. Do I need to learn how to a stitch a wound?

Stitching a wound is easy and is easily learnt. You can teach yourself. The challenge is knowing when to close a wound or when to leave it open and not stitch it – that is the real challenge. This is covered in detail in **Ch.11**.

5. I think I have a hernia? What can I do?

A hernia is a bulge in a muscle wall. They can be internal or external. Most common are bulges through the abdominal wall – either around the umbilicus (belly button) or over the inguinal ligament through the inguinal canal. Knowledge of anatomy is important here, to recognise exactly what sort of hernia it is.

They are usually precipitated by a straining activity such as lifting, but sometimes the trigger is not clear.

A hernia itself is not a problem. It is an uncomfortable bulge – which often increases in size over years often to a large size. The problem arise from what is inside the hernia. As a hernia gets bigger in size bowel can move from the abdominal cavity can move into the hernia sac. Most of the time with gentle pressure the bowel contents can be pushed back into the abdominal cavity. Problems arise if the bowel gets stuck or if it twists inside the hernia sac leading problems with its blood supply. This is a surgical emergency and can prove fatal in austere situation and if it cannot be reduced with firm direct pressure, it is not amendable to austere treatment.

Modern therapy involves surgical repair of the defect completely to stop the bulge occurring. Austere treatment is aimed at holding the hernia sac back inside the abdomen and stopping it from bulging out. This would involve designing and making a corset or a belt which firmly supports the area where the hernia is occurring – either the abdominal wall or the groin.

6. My patient needs to pee, and he cannot!

You need to decide if the patient is not passing urine because they are not making it (i.e. they are dehydrated) or if they are having a problem passing urine and their bladder is full. Gentle pressure on the lower abdomen should be uncomfortable for a patient with a full bladder – increasing if the bladder is overfull – at which point on a slim to medium build person you can feel a balloon like mass arising from the pelvis.

If their bladder is full and they cannot pass urine, they have urinary retention. This is painful and ultimately can cause acute kidney failure and death over a week or so.

Inability to pass urine is most common in older men with prostate problems. It is seen sometimes with urinary tract infections. It is rare in women.

Treatment:

Sometimes the sound of running water is helpful, as is standing up in a warm shower. If there is a cause such as a UTI, then treat cause if possible.

If the above simple measures fail to achieve a result, the patient may require a urinary catheter (IDC – Indwelling catheter). This is the insertion of a catheter (a small hollow rubber or elastic tube) through the urethra into the bladder. It is not usually difficult, but there are a few risks

Technique:

Catheterization is not hard most of the time. Having one or two gentle attempts is reasonable for a lay medic with some basic training. Catheterization is uncomfortable/mildly painful, but it should not be agony. If it causes extreme pain, stop.

Women. Women are easier to catheterize than men. As per the diagrams the external entrance to the urethra is just above the entrance to the vagina. The urethra is straight and about 6-7 cm long.

- Choose the correct size – 12-18 Fr for adults – average size 14 Fr.
- Clean urethra meatus with disinfectant or clean water.
- Keep everything sterile if possible. If you cannot use sterile gloves, non-sterile are ok or well-washed hands.
- Lubricate the catheter with a water soluble lubricant.
- Slide the catheter in.
- When urine begins to drain, advance 1cm further and inflate the balloon, if this causes significant pain, deflate the balloon, advance 2cm further and try again.

Men. Men are potentially much harder. Because the urethra is longer (16-20cm) and goes around several corners before reaching the bladder the male urethra needs to be really well lubricated. The basic technique is the same as for women – just longer with a few angles. Start with the penis pointing towards the roof and gently advance. The main bend is within the prostate gland, about 10-12cm into insertion. At this point adjusting the angle so the penis is pointing towards the floor, sometimes makes insertion easier. Once draining, use the same technique as above for inflating the balloon.

YouTube is full of great videos demonstrating catheterization.

What happens next?

You cannot leave an IDC in forever. In the first instance leave in for 48 hours and remove. If the patient can pee – great. If still unable to pee, replace and leave in for one further week and then remove and try again. Most people will be able to pass urine by themselves again. A small number may need to reinsert long-term. An IDC will get colonized with bacteria, and after a while, will lead to infection.

If inserting a urinary catheter is not an option, suprapubic aspiration, where a needle is used to suck urine out of the bladder (aim for 150-200ms) and into a syringe, but it is NOT left in. This provides temporary relief of an over-distended bladder – sometimes by reducing the volume in the bladder the patient is able to pass urine themselves.

If you have no catheter or you are unable to pass a catheter = problem. An over full bladder is easily felt rising out of the pelvis. Occasionally a small hole needs to be cut between the skin and the bladder immediately above the pubic bone needs to be cut – this is called a “Suprapubic” approach but we will not describe it in detail here.

7. Why else is being able to pass a catheter important?

One the key aspects of managing a sick person is how much urine they are making. This is a default measurement of how the internal organs are being perfused by blood. The only accurate way to measure urine output is to place a urinary catheter as described above and draining it into a measuring bag or collecting it into a measurement container.

8. My friend has bad abdominal pain, what is it?

Abdominal pain always comes back to anatomy. Location of the pain and nature of it gives you your differential diagnosis of the cause of the pain. Like with chest pain there are two sorts of pain:

Visceral – this is pain from the effected organ. It is often poorly localized and is felt as diffuse pain over a wide area.
Peritoneal – this pain is much more localized and reflects direct peritoneal irritation (which has a more precise nerve supply) – but occurs later as the disease progresses and more inflammation is present.

Central abdomen Any organ generally – visceral pain Bowel Aorta	**Right upper quad** Liver Gall bladder Pancreas	**Epigastrium (**middle at the top) Liver Stomach Pancreas Bowel	**Left upper quad** Not much! Stomach Spleen
Left lower quad Bowel Ovary	**Supra-pubic** (middle at the bottom) Bladder Uterus	**Right lower quad** Bowel Ovary	**Flanks** Kidney's Aorta

Location of pain in relation to underlying organs

There is a vast list of possible abdominal pain. In some detail, here are some of the important ones:

i. Peritonitis

This is inflammation of the lining of the abdominal cavity. The most likely cause depends on history

1. Inflammation - Pus → Infection
2. Trauma - Blood → Organ injury
3. Trauma - Bowel contents → Bowel injury

It presents as severe generalised abdominal pain, associated with nausea/vomiting /fever. The abdomen is very tender and usually feels rigid like a piece of wood.

Without surgical intervention, it is likely to be fatal in most patients in an austere situation:

Make the patient NPO (nothing by mouth) – this rest the gut – for at least 72-96 hours.
Start IV fluids/Rectal fluid if available to maintain blood pressure and perfusion.
If not available encourage small sips of oral rehydration fluid regularly – aim to get 20mls every 15 minutes.
Administer high dose antibiotics if available

- Augmentin 1.2 gm IV 6 hrs or
- Ceftriaxone 1gm IV 12 hrly + Metronidazole 500mg IV 12 hrly

Given strong pain relief.
See further discussion in the Major Surgery chapter.

ii. Appendicitis

This is inflammation of the appendix – this is a small worm like attachment on the beginning of the large bowel

Presentation: It usually starts with vague central abdominal pain as the inflammation gets worse it localises to more severe RLQ pain. The patient often also complains of nausea/vomiting/diarrhoea/ low grade fever. If perforation of the appendix occurs, then the patient will rapidly deteriorate as they develop localised or generalised peritonitis.

Diagnosis: The diagnosis is based on the classical story. Some classical features in addition are:

- Anorexia – having no desire to eat at all.
- Failed hop test – ask the patient to hop on their right leg, if it causes a significant increase in pain or the patient is unable to hop and it is associated with a good story it makes appendicitis likely.
- Rovsig's Sign: push on the left lower quadrant. If this causes pain in the right lower quadrant (RLQ), consider appendicitis likely.
- Psoas Sign: lie flat on bed, raise right leg. If this causes RLQ pain, consider appendicitis.

Differential: Things that look like appendicitis are only appendicitis 25% of the time. Most of the time the diagnosis is a viral infection causing abdominal pain and it can be very difficult to tell the difference – the sicker the patient is, the more likely it is to be appendicitis.

Consider as a possible cause:

Viral infection, especially if lymphadenopathy present
Ovarian cysts or bleeding
UTI
Ectopic pregnancy – in women

Traditional treatment is the surgical removal of the appendix (and this is discussed in the Surgical chapter). However, there is evidence that for most patients, high-dose antibiotic treatment is lifesaving in settling the infection down.

The broad approach is the same as for peritonitis:

Nothing by mouth
Pain relief
Fluids
High dose IV antibiotics per peritonitis (usually ampicillin, gentamicin, metronidazole).

iii. Peptic Ulcer Disease

This is an irritation or ulcers of the stomach or top part of the small bowel. This is generally due to excess acid production (but can be made worse by a co-existing bacterial infection – Helicobacter pylori). Anyone presenting with symptoms of peptic ulcer disease should receive a 10 days course of a daily table spoon of honey, which has shown to be effective in eliminating the H. pylori bacteria – the evidence is mixed but there is a suggestion of benefit.

Classically it presents with burning epigastric pain. Relief usually comes with eating. It comes and goes. The severity can vary from a mild ache in the epigastrium to severe pain associated with nausea and vomiting.

Treatment is with antacids (generally in the form of a calcium or magnesium-containing compound) and acid-reducing medications. There are two types – Ranitidine or Cimetidine (H1-blockers) and Omeprazole (proton pump inhibitor reducing acid) – both in most jurisdictions are available over the counter so it is possible to stock up on these medications.

The main complication is perforation, which is fortunately unusual, characterised by:
Severe epigastric pain/rigid abdomen and localised peritonitis.
The only treatment is surgical, although high dose antibiotics could be tried. The problem is there is a hole in the stomach, and that hole needs to be plugged – otherwise the leak continues.

iv. Gall Bladder Disease

The anatomy once again is important. The gall bladder is tucked under the liver in the right upper quadrant of the abdomen. Its role is to store bile which is produced in the liver and helps break down fat when we eat. The bile is released into the gut down the bile duct into the small intestine

We see three disease problems with the gallbladder:

- Stones in the gallbladder – biliary colic
- Infection of the gallbladder - Cholecystitis
- Infection of the bile duct - Cholangitis

Stones in the Gallbladder (biliary colic)
It's common - 10-15% adults. The classic patient group is covered by the 4 “F’s” – fat, female, forty, fertile. Although it can affect either sex and at any age.

It presents with RUQ pain. Classically the onset over 30-60 minutes, lasts for several hours and slowly settles. It is frequently triggered by a fatty meal, but can occur spontaneously.

The pain is usually described as spasm type pain – colic – pain which comes and goes. The patient often wants to move around.

Treatment is primarily pain relief. The problem is that biliary colic is usually recurrent. Surgical removal of the gall bladder is the only definitive treatment.

Hyoscine butylbromide (Buscopan) and NSAIDs are an effective combination, and are available as OTC drugs (Please Note: Buscopan is no longer available in the United States).

Cholecystitis
Cholecystitis is the inflammation/infection of the gall bladder. It is usually triggered by stones. It presents with RUQ pain and fever. 1/3 of patients have a palpable tender mass in the RUQ. The treatment follow the same pattern as for other intra-abdominal infections (described above)

- Fluids
- Analgesia – to control pain
- Antipyretic – to treat fever
- Antibiotics
  Augmentin IV 1.2 gm 8 hrly.

Cholangitis
Is the infection in the biliary tree – the gall bladder, but also the drainage channels down in to the gut. It is often precipitated by a stone stuck in the biliary tree and presents with a classic triad, “Charcot’s triad” (which isn’t always present!!) of jaundice (a yellow colouring to the skin), fever and RUQ pain. It can be hard to tell the difference between cholecystitis and cholangitis in an austere situation.

Cholangitis is a surgical emergency – it needs to be removed. This is clearly not possible in an austere environment. Try high dose antibiotics as per peritonitis. Keep the patient "nothing by mouth", administer fluids and analgesia. The outcome is likely to be poor.

v. Pancreatitis

Pancreatitis is an inflammation of pancreas – which sits at the back high-up in the abdominal cavity.
It has extensive causes but the most common two are due to gall stones (blocking the drainage of the pancreas) or binge alcohol use. These account for 90% of cases. Other causes include mumps, trauma and drugs.

Diagnosis: The diagnosis can be difficult in austere situation. Usually the diagnosis is based on raised amylase or lipase, these is unlikely to be available and diagnosis is based on the clinical presentation. Severe epigastric pain → back is most common. Bruising of the flanks or around the umbilicus (bad signs) and sometimes jaundice

Management: Rest both the patient and their gut – bed rest and keep the patient "nothing by mouth". IV or rectal fluids and pain relief. Pancreatitis will test your patience, you cannot hurry restarting oral intake.

vi. Diverticulosis

The large bowel has some structural weaknesses in its design. As some people get older small bulges can occur through these weaknesses – resulting in little "out-pouches". It can occur in the large bowel on left or right side of the abdomen – although it more common on the left side.

There are several different presentations:

Rectal bleeding - usually painless or associated with vague gripping LLQ pain and there is no specific treatment
Diverticulosis - small amount of stool gets trapped causing local irritation. Usually this presents are LLQ which comes and goes
Diverticulitis – this is local inflammation/infection or abscesses in the diverticuli. It presents with LLQ pain/fever/tenderness/rectal bleeding. Perforation can occur causing peritonitis. Treatment is a high fibre diet (good general treatment for bowel problems), plenty of fluids – either IV or orally if tolerated. Consider Augmentin orally if not overly unwell/IV if significant systemic symptoms.

vii. Bowel Obstruction

A bowel obstruction is exactly that – the bowel – either the small or large bowel - becomes mechanically blocked, preventing the movement of ingested food or feces.

Small bowel. Usually caused by previous surgery causing adhesions**.** Presents with – nausea, vomiting and central abdominal pain and distention.

Treatment – the goal is to rest the bowel and decompress the top portion of the bowel, in the hope that the obstruction will resolve spontaneously.

- Make the patient "nothing by mouth".
- If available, pass a nasogastric tube.
- IV or rectal fluid administration.
- Analgesia.
- Antiemetics – anti-sickness medications.
- Wait and see:
  → Patient will either get better with above care or die.

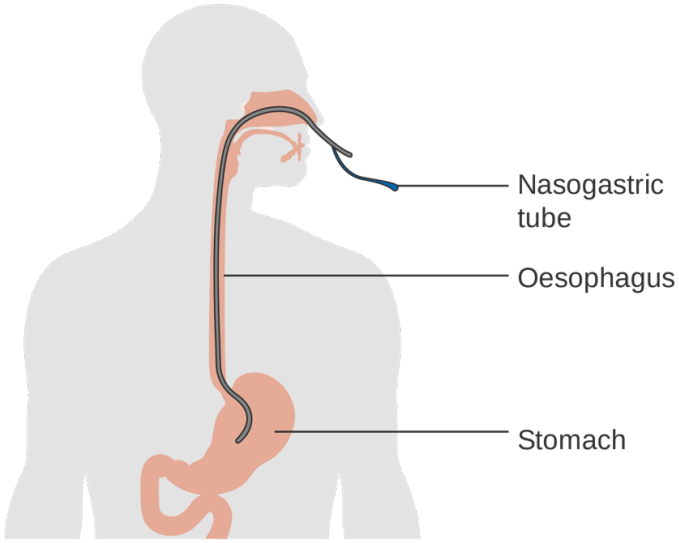
Large bowel. Usually caused by cancer. Can be more insidious onset than small bowel obstruction Distention + pain + reduced or absent BM/wind. The natural history of large bowel obstruction generally follows this path:

- Untreated bowel becomes more distended.

- Blood supply is impaired by pressure.
- Bowel wall infarcts.
- Perforates → peritonitis.
- Patient will die without surgery, antibiotics will not help.

9. What is a nasogastric tube?

A nasogastric tube is used to relieve excess pressure and fluid from inside the stomach and it also provides another route to administer liquid food or fluids to an unconscious person.



Nasogastric tube placement. (Wikimedia commons).

It is indicated when:

- Persistent vomiting or abdominal distention due to possible bowel obstruction.
- Suspected peritonitis.
- Long-term feeding in patients who cannot eat.

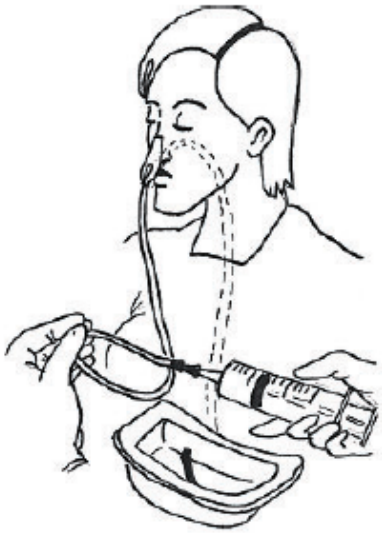
A nasogastric tube is a small plastic tube that goes from the nose or mouth to the stomach. Like many minor surgical procedures, it is not complicated. Like urinary catheterization, YouTube has a number of excellent videos demonstrating insertion techniques.

They come in a variety of sizes – the average size in an adult is 14 or 16 french. In children use a smaller size – 8 or 10 french.
Sit the patient up if possible
Have the patient slowly sip water through a straw
Open the packaging and remove the NGT from its plastic sleeve.
You will need to lubricate it with cooking oil or a lubricant like K-Y jelly. Measure the length of the tube from nostril to the mid-point of the left upper quadrant – the rough location of the stomach.

Gently insert the tip into the patient's nostril, pass it straight backwards towards the back of the mouth. Tell the patient to start swallowing as soon as they feel it touching the back of their throat – drinking small sips of water will help.

Pass the tube to the measured length – usually it will pass down the esophagus easily. The average depth is usually 55-65cms

Use a syringe to gently suck back on the tube to ensure that some stomach contents is aspirated tape in place and attach to a drainage bag/tubing of some sort below the level of the patient to encourage drainage.



10. What if it was a teenage girl presenting with the lower abdominal pain?

The basic approach is the same. Knowing the anatomy is key and realising women have a couple of extra things that can go wrong.

There are several different diagnoses to consider in woman (particularly those of reproductive age)

1. **Ectopic pregnancy:**
   An ectopic pregnancy is one which grows in the wrong place, usually in the fallopian tube – they are fatal without treatment 90% of the time (that's an educated guess – no one knows for sure as most get operations now – women did survive ectopics prior to wide spread surgery – but getting exact statistics is hard.) - but a small number will resolve themselves.

   The problem is the pregnancy releases hormones and local mediators which increase blood flow so the blood vessels get big and flow increases. When they grow too big for the space they are in (the fallopian tube is small and doesn't really stretch) they rupture and bleed. It's the bleeding which causes shock and potentially death. The clinical presentation is usually in the first 6-7 weeks of pregnancy (range 4-12 weeks) and is usually unilateral lower abdominal (pain on one side) +/- vaginal bleeding. If you gently feel in the vagina by the cervix it is usually very painful on the affected side – moving the cervix makes the pain a lot worse.

   In terms of austere management – there isn't much you can do. Bed rest, leg elevation and treat shock. In the same way that it is possible to do an appendectomy, it is also possible to do something surgical in a primitive environment – a mini-laparotomy (as described in the surgery chapter) and tying off anything that is bleeding on the tube is a simple operation and certainly no more complicated than an appendix.

   General rule of thumb – unilateral lower abdominal pain (i.e. on one side only or a lot worse on one side) + positive pregnancy test (or clinical suspicion of early pregnancy) = ectopic pregnancy. Recognition of pregnancy is very important – stock up on pregnancy test kits.

2. **Ovarian cyst pain:**
   An ovarian cyst is a collection of fluid on the surface of the ovary – most are small 1-2cm and occur normally (when an egg is released it leaves behind a small cyst). They become a problem when they get big 5-10+ cms.

   Two things can happen. First, they can become so big they cause the ovary to twist on its stem which contains its blood supply – resulting in severe unilateral lower abdominal pain. The ovary eventually dies from lack of blood and the pain stops – over 12-24 hours. Currently it is a surgical emergency, to save the ovary – the sooner the de-torsion of the

stem occurs, the more likely it is to survive. In an austere situation, manage the pain as you can and unfortunately the ovary is allowed to die (though pregnancy should still be possible, provided the other ovary is still functional).

Second, the cyst can rupture and spill its contents into the abdominal cavity – usually small amounts of blood or serous fluid. This causes a chemical peritonitis and can present like a lower abdominal peritonitis. It usually resolves spontaneously.

3. **Pelvic inflammatory disease:**
   A severe sexually transmitted infection (discussed above) but think of it as fever + right or left sided pain + negative (or minimally abnormal) urine dip-stix +/- smelly vaginal discharge in someone who is sexually active.

11. My patient has a painful, itchy bum. How do I deal with that?

There are three common presentations, but the treatment is broadly the same.

Puritis: This is perianal itch and it can be almost insanely annoying and distressing. It has many causes but the most common two are poor hygiene or irritation from the poo.

Hemorrhoids: There are two types - External and internal. Defined as being above or below dentate line – that is the point the skin changes to the smoother/wetter lining of the bowel (known as mucosa) These present with a palpable lump – on inspection they appear covered in skin and sitting just outside the anus, they are external hemorrhoids. If they look like they are hanging from the anus like a small grape and are covered in a moist shiny layer they are most likely internal.

Anatomically they are vascular cushions which support the passage of the poo, but the supports for them deteriorates with age and significant straining.

They present with - swelling/itch/bleeding.

Fissure: This is a crack in the skin around the anus. The skin splits and then is slow to heal – it is usually a consequence of passing hard poo's. The consequence is painful defecation.

Management: The basic management of all perianal problems is the same.

WASH = **W**arm water – wash with warm soap and water and air dry.
Analgesic agents – analgesia (preferable not codeine or other narcotics, these make constipation worse).
Stool softeners – in the form of fresh fruit or specific medication like Metamucil ©.
High fiber diet.

A mild steroid cream like Hydrocortisone 0.5% or 1% can also be useful for symptom relief.

Specifically, with hemorrhoids – Internal hemorrhoids can often be reduced with firm pressure. However, the longer they have been out the more unlikely they are to be able to be reduced.

"External hemorrhoids" (perianal hematoma):
0-24 hours: can be aspirated with a large needle and syringe.

1-5 days, incise and drain.

Over 5 days, leave alone unless infected (uncommon).

H. Orthopaedics

1. Is it a sprain or a fracture?

Low-tech diagnosis of long bone (lower leg, thigh bone, humerus, forearm bones) fractures are discussed at length in the Primitive Medicine chapter. What we are talking about here is really wrists, ankles and knees – when is something broken and when is something sprained.

The simple answer is if the swelling goes down, it's working normally and not overly sore within a week to 10 days it was probably a sprain. If it remains swollen, it is hard to walk on or use or is still significantly painful it is probably a fracture.

Look for deformity (compare both sides of patient).
Try applying longitudinal force along the bone (like shutting up a telescope by shortening it). In the case of a fracture, this will often cause pain.

2. How do I "set" a broken bone?

The basics of fracture manipulation are straightforward. You need to correct any angulation of the bone (i.e. straighten the bone) and then you need to pull it to length and keep it at length if required and then immobilize it while the bone heals – 6-8 weeks. The main problem is it is extremely painful to do. In the case of the thigh bone (femur) another problem is overcoming the action of the very strong muscles of the thigh, which act to try and shorten the bone. To maintain length on the femur will require weighed traction to overcome the muscle action for several weeks at least. The options for splinting a limb and/or establishing traction are many and varied but the basic principles described above are the same.

The larger the bone, the longer it needs to heal. Fingers, for example, will generally heal in 7-10 days, by which time the neighbouring joints will be a bit stiff from lack of use.

Fractures where the bone is in multiple fragments (comminuted) are less likely to heal well. Fractures which break through the skin (compound) will almost certainly, in an austere environment, become

infected. A compound fracture requires that the bone ends and wounds are thoroughly washed out, then standard fracture management principles applied and high dose antibiotics administered. A compound fracture was one of the commonest causes of limb amputation prior to antisepsis and antibiotics.

3. How do I deal with a compound fracture?

A compound fracture is one where the broken bone breaks the skin and is exposed to the air and environment. They are much more complicated and risky than simple fracture. Often they are grossly contaminated with dirt and debris. In an austere environment, they are potentially fatal or result in the need for amputation.

The low-tech approach consists of:

- Cleaning the wound and bone ends to remove any visible dirt or debris.
- Debridement and removal of any obviously dead tissue.
- Irrigation of the wound and bones ends with copious volumes of fluid – we are talking 5-10L+ of sterile water or saline – the goal is to bring the contamination levels as low as possible – 'the solution to pollution is dilution'
- Reduce the fracture and approximate the bone ends
- Leave the wound open for delayed primary closure – see chapter 11 Wounds. Loosely pack the wound and cover with a dressing
- Splint or traction the limb
- If available give the patient broad spectrum antibiotic – Ceftriaxone, Amoxicillin and Clavulanic acid, Ciprofloxacin.
- Reassess the wound after 72-96 hours for signs of infection and consider closure of the wound.

If it is possible to avoid infection the ongoing management is that of a standard long bone fracture.

Despite this the risk of the need for Amputation remains high

On occasions, there are multiple fragments of bone visible in the wound. The same process, as above, should be performed and if it is obvious where the fragment sits it should be replaced in the approximately right position. If it is not obvious where it goes it should be removed. The chances of a multi fragment compound fracture healing in a satisfactory manner is very low – and amputation is likely.

4. How do I deal with a broken jaw?

Broken jaws can occur from a punch to the face or from any other direct force injury to the jaw

As has been stated above to heal properly the broken bone ends need to be help close together and movement minimized. Current management involves the use of small metal plates (like mecarnno) placed across the fracture and screwed into place. In an austere environment, unfortunately the

treatment involves splinting the lower jaw to the upper jaw for 4-6 weeks to enable the lower jaw to heal.

There are several approaches to this and they are discussed in more detail in the Dental chapter.

5. What is a dislocated shoulder (or ankle) and how do I treat one?

A dislocation occurs when one half of a joint becomes 'disconnected' from the other half of the joint. The most common types of dislocations are shoulders, ankles, fingers and elbows. These are discussed below.

While individual dislocations and their reductions are discussed below, the general principles of reduction apply to all types of dislocations:

Reassurance +++ to the patient
Simple analgesia if available
Sustained traction should be applied to the limb or digit (except for patella dislocations)
Lots of patience is required

Shoulder Dislocations:

The shoulder joint is a relatively unstable joint – the humerus bone (the upper arm bone) sits in shallow cup (the glenoid fossa) of the scapular and relies on muscles, ligaments and tendons for stability. Approximately 95% of dislocations are anterior (the humerus dislocates forward relative to the scapular) – the reduction techniques described work best for anterior dislocations. The other 5% are called posterior dislocations – where the humerus dislocates towards to the back relative to the scapular). The Stimson technique can be used for a posterior dislocation – telling the difference clinically can be difficult and it is reasonable to assume a clinical dislocation is anterior. This classically produces a 'squared shoulder' appearance`;

anterior shoulder dislocation. Wikiradiology.

Before attempting a reduction, you should first ensure that you are dealing with a dislocation and a problem with the clavicle. You can rule out (mostly) a clavicle fracture or acromioclavicular joint dislocation by palpating along the clavicle from the mid-line by the sternum laterally to the acromioclavicular joint. This should not be deformed and mostly non-tender.

Rule out a fracture of the humerus, start at the elbow and work up palpating the humerus – in a dislocation the pain should be localised to the top of the humerus and the arm pit.

Relaxation of muscles is one of the most important aspects of relocation. This requires lots and lots of reassurance, pain relief if available, sustained traction and patience – doing it slowly increases the chance of success. The shoulder should relocate with sustained traction and no force should be used during the manoeuvres described.

There are multiple different techniques for reducing dislocated shoulders – none are 100% successful all of the time. We recommend two different techniques:

1. The Stimson Technique:

Place the patient prone (face down) on a bed or table with their affected arm hanging down towards the ground. Ensure the bed or table height is such that their arm does not touch the ground. Apply continuous downward traction on the hand or wrist for several minutes. .

If the shoulder does not relocate after several minutes, maintain the traction and gently rotate (supinate) the hand and wrist outwards. Maintain this position for several minutes.

If this is unsuccessful get an assistant to apply scapular rotation. Push the lower pole of the scapula (shoulder blade) towards the spine, while maintaining downward traction on the arm.

2. The Modified Kocher's Technique:

Position the patient supine (lying on their back) or sitting, with the arm by their side.
Bend the elbow to 90 degrees.

Apply traction to the humerus and slowly externally rotate the arm until resistance is felt (usually approximately 45 degrees). Slowly abduct the arm, as if to scratch the back of the head.

Push gently on the head of the humerus.

When the shoulder relocates (this will be indicated by a palpable or audible clunk, relief of pain, return of a normal shoulder shape, and return of normal (or near normal) motion of the shoulder joint, place the arm in a sling. The patient keeps the arm in a sling for 72 hours and avoids using the arm unnecessarily. The patient should gradually start using the arm again after that, but being careful to lift the arm above their heads for 10-14 days.

Immediately following reduction, regular paracetamol (Tylenol) or an anti-inflammatory are usually appropriate if available.

Patella Dislocation

Patella dislocation occurs most commonly in adolescents or young adults, following twisting on a bent knee. Sometimes it can occur due to a direct blow.

The patella dislocates to the out-side (lateral) aspect of the knee and this needs to be confirmed by gently palpating it. Patients sometimes describe swelling on the inside of the knee, but this results from prominence of the underlying femur which is no longer covered by the patella. A dislocated patella is not the same thing as a dislocated knee – a dislocated knee occurs when the tibia is displaced off the femur. It is uncommon.

Give the patient oral pain relief if available. Packing the knee in ice for 5-10 immediately prior to a attempted reduction can be useful if available. Bend the knee to approximately 45 degrees (it will often already be in this position), grasp the patella firmly with your hand and push it inwards (medially) while simultaneously have an assistant straightening the knee.

A successful reduction is indicated by – a reduction in pain, a return to normal knee shape and an improved range of movement in the joint.

Post reduction: strap in place.

Ankle Dislocation

An ankle dislocation may involve the subtalar joint which separates the foot from the ankle, or it may involve the ankle joint itself. The clinical appearance is often similar for both types. Usually an ankle dislocation is accompanied with fractures around the ankle joint. The presence or absence of fractures (including compound fractures) does not alter the need to relocate/realign the ankle if clinically indicated and the technique is the same.

Ankle fractures are frequently painful and ideally require strong pain relief or even an anaesthetic.

Apply firm traction along the axis of the leg to the forefoot, while an assistant hold the leg at the knee and provides traction in the opposite direction. Relocation will often correct with a 'clunk'. Dislocations with fractures may produce a grating sensation with no clear end-point. If this occurs continue applying traction until the foot is aligned with the leg.

The foot will require immobilisation for 4-6 weeks and gentle mobilisation following.

If it is a compound fracture/dislocation (i.e. the there is a cut overlying the dislocation and the joint is open), it should be managed as for a compound fracture (described above) and copious irrigation (litres) of the joint with boiled water (or saline) and the patient started on a broad spectrum antibiotic.

Hip Dislocation

A dislocated hip most commonly occurs in the setting of someone who has had a hip joint replacement. A dislocation of a normal hip is unusual and requires a lot of force for it to happen, as the hip joint is a deep and stable one.

Relocation usually requires deep sedation or anaesthesia. Details around this are discussed in more detail in the Anaesthetic chapter.

The hip area is very painful and the leg may be shortened +/- rotated. This appearance can also happen in a fractured neck of the femur (NOF), common when elderly patients fall.

The patient should be positioned on the floor. Their hip should be bent perpendicular to the floor and knee flexed. An assistant should stabilise the pelvis and prevent it moving. Traction towards the ceiling should then be applied along the length of the thigh. Reduction is generally confirmed by a loud 'clunk' and a return to normal length with relative pain-free further hip movements.

Finger Dislocations

Apply longitudinal traction along the finger until the joint relocates. A ring block with local anaesthetic may be useful if available. In the absence of good pain relief, just provide slow traction along the finger and don't rush the procedure.

When reduction occurs, splint the finger to adjacent fingers for 1 week and then mobilise gently. Do not splint fingers straight, rather slightly curved. It is common for dislocated fingers to be associated with a fracture of the same finger.

Elbow Dislocation

The elbow usually dislocates backwards relative to the humerus bone. As described for hip dislocations, the patient may require deep sedation if available.

Apply firm longitudinal traction to the forearm, while an assistant generates counter-traction on the upper arm. A 'clunk' and a return to a normal shape will indicate a successful reduction.

The elbow should be placed in a broad arm sling for 7 days if practical. Elbow dislocations are often associated with small fractures.

I. Eye, Ear, Nose, and Throat (ENT) Problems:

1. Is there a general approach for someone who presents complaining a painful eye?

Yes, eye first aid. Eye problems in an austere situation will fall into 2 groups: they either get better by themselves with minimal interventions or the patient suffers a substantial loss of vision and can go blind. While pretty simplistic – that does reasonably accurately describe eye problems in an austere environment.

The concept of eye first aid covers the simple things which can be applied to any painful sore eye regardless of the cause:

- Irrigation with cool clean water
- Cool compresses placed over the eyes and changed frequently.
- Paracetamol (Tylenol) or Ibuprofen for pain
- Patching both eyes - rest the eyes – they move less and blink less both of which can exacerbate pain – but you need to cover both eyes due to reflexes across both eyes. There is no evidence this actually improves anything – but in some people it does help substantially with pain management.

In assessing the eyes, one of the most important aspects is if the eyes are working or not. This is discussed in the eye examination section of the Clinical Assessment chapter . In summary, we test each eye using a Snellen chart or if one is not available ask the patient to read with each eye a standard US trade paperback at 30cms. If the patient can do that, the vision is close to normal.

Ensure pupil reflexes are tested – as described in the assessment chapter above.

2. My patient's eye was scratched by a small tree branch and now it hurts. What should I do?

Eye first aid treatment starts immediately. It is likely they have a corneal abrasion or ulcer. The can follow a scratch or bit of grit getting in the eye – from something like dust or grinding debris.

The abrasion is over the cornea in the central region of the eye. The patient presents complaining of blurred vision/pain/scratch or ulcer is usually obvious – but if not, changing angle of beam from the flashlight you are examining the eye with will usually show it up if you don't have fluorescein to stain the eye (as discussed in the Assessment chapter).

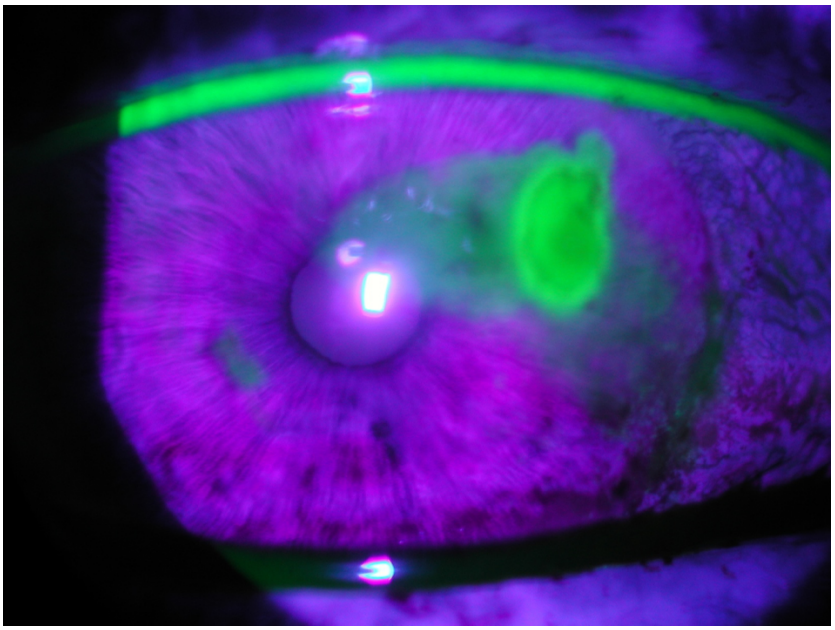
In terms of differentiating between an abrasion or a ulcer, rather than something that appears like a scratch on the surface of the eye, a crater looks more like a small crater. Some ulcers can be traumatic and some can be infective and telling the difference can be difficult.

Treatment.
If a foreign body (FB) is present it should be removed. The eye should be washed with warm clean water. If available antibiotic eye drops should be used – especially for corneal ulceration, although in corneal abrasions they are of dubious value. Simple analgesia should be used liberally as corneal ulcers or abrasions hurt.

Removing a foreign body:

- Currently we use local anaesthetic first prior to trying to remove a corneal foreign body. Without local anaesthetic eye drops the big problem is blinking – it can make it nearly impossible to access the eye. You need to splint the eye lids open – you can fashion this from a paperclip – make sure sharp ends are pointing out.
- First, attempt to remove the foreign body with irrigation with warm water
- Second, try swiping it off the surface of the eye with a wet cotton bud.
- Third, you can try using the side of a hypodermic needle (need a steady hand!) Resting the operating hand on the patient's cheek will help. Metallic FBs can leave a rust ring after removal – that a halo of permanent staining around where the foreign body was. This will lead to permanent staining and vision defect (if right on the front of the eye) if not removed – if you have the confidence it can be superficially dug out with side of needle – literally scoop out the rust.

A small number of patients develop an eye ulcer due to facial herpes – consider this if presenting with evidence of a corneal ulcer and evidence of herpes lesions/ulcers on the face. Viral ulcers can lead to visual loss and there is no meaningful austere care beyond what is described above.



A corneal abrasion on the surface of the eye.

3. What do I do for a patient who has splashed some car battery acid in their eyes?

Splashing chemicals in your eyes is very common.
As stated elsewhere – "the solution to pollution is dilution". You need to irrigate the eye continuously for 15-20 minutes. When this is done, fortunately, damage is relatively uncommon.

Alkalis (caustic soda or lye) are worse than acids but both need copious irrigation.

During the irrigation, you should lift both eye lids and irrigate under them. Following irrigation, it may be useful to patch both eyes for 24 hrs. Ongoing pain suggests damage has been done and it may impact on vision. There is limited austere treatment beyond irrigation and analgesia.

4. Both the patient's eyes are red and itchy and sore. They are making a lot of tears.

It is likely that the patient has conjunctivitis. It can affect one or both eyes – but usually both.
The conjunctiva becomes red and inflamed – it's important to remember what the conjunctiva is – it is a thin membranous layer lining the eye lids and onto the edges of the eye, but doesn't extend into the central corneal part of the eye. The cornea is clear and vision is usually ok. The patient often wants to rub their eyes, which makes it worse.

It can be – viral (common), allergic (very common) or bacterial (rare)

Treatment.
The austere treatment is essentially the same regardless of cause: Anti-histamines if available and irrigation and cleaning to remove discharge. Cold packs can help. Usually conjunctivitis settles spontaneous over 48-72hrs if infective. Allergic conjunctivitis tends to wax and wane over time.

Allergic conjunctivitis – note the swollen eye lids and red conjunctiva.

5. The next patient just has a unilateral painful red eye. Is that conjunctivitis?

Conjunctivitis usually (but not always) effect both eyes. It also isn't usually generally painful – it is absolutely uncomfortable – the eye feels irritated and itchy – but patients generally don't complain of pain.

There is a saying in medicine – "beware the unilateral red eye". This is because anything affecting one eye only which causes a lot pain is generally bad. Things that cause the unilateral painful red eye are generally serious pathology and not much can be done in an austere environment – they are potentially sight-losing.

Two possible causes are – glaucoma or iIritis/scleritis.

Glaucoma: Glaucoma is an eye disease where more fluid is made inside the eye, then drains out. The pressure goes up either slowly (chronic glaucoma) or suddenly (acute). The eye is red, the sclera is red, it painful and rock hard to touch and often there is severe headaches behind eye. There are very limited treatment options in an austere environment.

Iritis / Scleritis: This is an inflammation of the area around the iris and sclera – including the cornea – the best way to think of it, is an inflammation of the eyeball itself. It has many causes both infective and inflammatory. The patient presents with a red and painful eye – often pus is in the anterior chamber (the curved cavity in front of the iris) and forms a fluid level in the bottom of it. The cornea can look hazy – like its gone from clear to opaque. Treatment consists of eye first aid and, if available, oral ciprofloxacin tablets or eye drops.

6. My patient has what looks like a big blood clot on their eye. What is it?

If it looks like blood clot trapped under the conjunctiva – even if it is quite big – it is probably a sub conjunctival blood clot. This is bleeding on the surface of the eye, but not over the cornea – the central part of the eye. It can occur spontaneously or from sneezing or from minor trauma. No treatment is needed, it just looks impressive.

If it is in the anterior chamber of the eye (in front of the iris/pupil), it is a hyphaema. Treat this like a bleeding nose which has stopped: sit up, no straining/coughing. Normally, this needs urgent review, but in austere situations, simple rest will reduce the danger to sight.

7. How do I manage a person who has been punched in the eye and cannot see clearly?

There are two types of eye injuries – penetrating and blunt.

"Penetrating" means that the injury has punctured a hole in the eye. Sometimes it is a big hole, but usually the holes are small – small nails or a fish-hook puncture the eye. The problem is the fluid from within the eye – aqueous – leaks out the hole and essentially the eye collapses. There are limited treatment options. If you can see an obvious leak when you examine the eye you can potentially put a small drop of super glue or surgical glue over the hole and sometimes this is effective. Treat the patient with Ciprofloxacin if it is available and manage pain as you are able to.

"Blunt" means that force has been applied to the eye, and damage done, but the actual eye is intact. Usually it is from a direct blow. The patient may have a conjunctival haematomas, the pupil may be an odd size or shape and you may see blood floating in anterior chamber. The patient will have poor vision. These injuries are very painful and analgesia should be generous.

8. I think my patient has cellulitis, but it is around their eye – is that something special?

Essentially it is the same as cellulitis anywhere else. It is infection of the skin around the eye – the area is red, hot and tender. The importance of these infection is that the venous drainage around the eye is in part of the deep veins inside the skull - the risk is an infection here can track back to around the brain. Infection in these veins can be fatal

If it is mild – slight redness and minimal tenderness or confined to an eye lid only (often a blocked gland in the lid) – you can treat it with hot compresses alone and it will frequently settle down. If it is more severe and antibiotics are available then use flucloxacillin or amoxycillin/clavulanic acid if available.

If painful eye movements are present it suggests deeper infection and more risk of infection going deeper, this needs aggressive antibiotics if they are available.

9. There was a fight and someone has been punched in the nose. But it is bleeding quite heavily. What do I do?

In young people it is usually minor damage to lining of nose from trauma (like this patient), or due to minor infection, breathing dry air or picking their nose. In these patients, it is most commonly bleeding from the front of the nose. In older people, it is more likely due to chronic high blood pressure and the bleeding normally comes from the back of the nose and is harder to treat

Treatment

- Get patient to blow all the clots out of their nose
- If you have it, spray decongestant up the nose
- Then pinch firmly for 15 minutes - this usually works
- If still heavy and/or posterior bleeding you may need to pack the nose.
    - There are purpose-designed nasal tampons if they are available.
    - An alternative is to basically fill that side of the nose with ribbon gauze and essentially rely on the packed gauze to stop the bleeding.

- Leave the packing in for 48hrs and then remove.
- If you have flucloxacillin or amoxicillin/clavulanic acid or cotrimoxazole give 3 day course to cover risk of infection while the packing is in, if these are available.

10. The patient has had a runny nose, a low-grade fever and a cough for a couple of days. Now he has facial pain and frontal headache. What should I do?

It is likely sinusitis. Which is an infection or inflammation of the sinuses of the face – these are air pockets in the cheeks, between the eyes and beneath the forehead – all connect to the nose and it is generally an upper respiratory tract infection which spreads from there to the sinuses.

The patient classically complains of a headache, facial pain, nasal and facial congestion and has a fever. 95% of the time the cause is a viral upper-respiratory tract infection and there is no value to antibiotics. Treatment is with analgesia and decongestants. Often there is an allergic element to it and it is worth trying antihistamines if available. While most are viral, consider antibiotics if the patient has high fevers and systemic symptoms such as rigors, chills, nausea and/or vomiting.

11. Why are sore throats important?

Most throat infections are viral. A much smaller percentage are due to bacteria and the most common bacterial cause is Strep pyogenes (or Group A strep)

The reason the distinction is important is two-fold. First, viral throat infections do not need antibiotics. Second, in crowded Third World (Post SHTF?) conditions, patients with bacterial strep throat are at risk of developing rheumatic fever (RF) and presenting with severe heart or kidney damage. Early treatment with antibiotics reduces these complications.

There is no certain way of telling between a viral sore throat and a bacterial one except a throat swab. Generally bacterial infections are more likely to have:

Temperature >38°C (100.4°F)
No cough
Swollen, tender anterior cervical lymph nodes
Tonsillar swelling or exudate

A viral infection is less likely to have these features and more likely to be associated with a cough or a runny nose or facial congestion.

The groups most at risk of rheumatic fever are those living in poverty, indigenous peoples and children and young people.

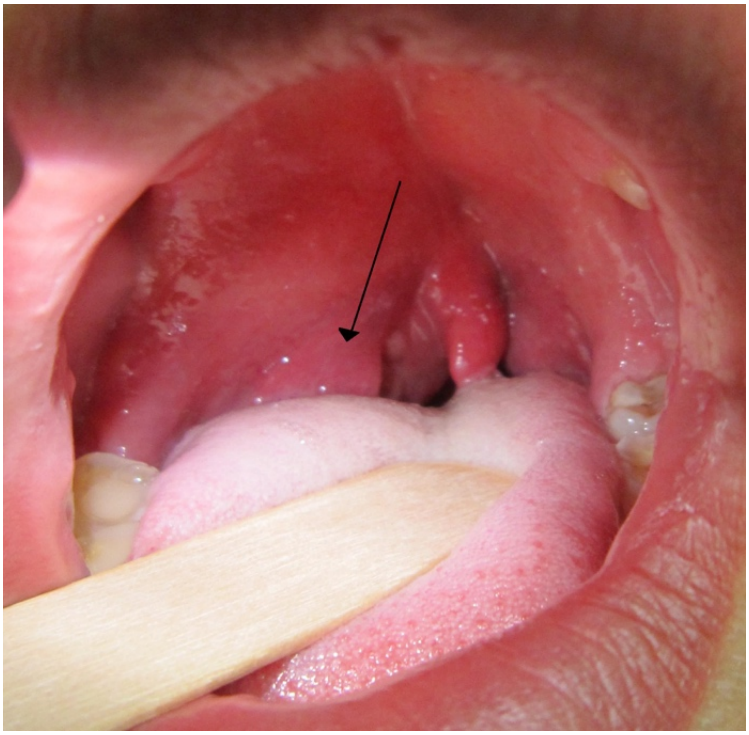
Anyone who likely has a bacterial infection and risk features for rheumatic disease should be treated if possible with an appropriate antibiotic – Penicillin, Cephalexin or Amoxicillin. In a patient with a Penicillin allergy consider giving a macrolide type antibiotic if available.

All other patients can be managed symptomatically: maintain hydration, paracetamol (Tylenol) or a non-steroidal for pain and fever and rest. For most the symptoms will resolve over 48 hrs. Maintaining hydration is the key issue here.

12. What is Quinsy?

Quinsy (peritonsillar abscess) is when tonsillitis turns into an abscess. Usually it occurs because of an untreated bacterial tonsillitis not being treated. Untreated it can result in an obstructed airway and death. Fortunately, they are relatively easily treated.

Recognition: Quinsy needs to be distinguished from simply swollen and enlarged tonsils. A peritonsillar abscess is in front of the tonsil and pushes forward from the throat into the back of the mouth cavity. The structures can be seen pushed forward.



peritonsillar abscess of the Rt tonsil.

Treatment: The treatment is simple incision and drainage or aspiration. Once you have seen quinsy you will recognize it.

Another technique is to use a large bore needle, with the needle cap still on. Cut the cap so that only 5-10mm of needle protrudes. This ensures the needle will only penetrate a short way, to reduce the risk of puncturing the carotid artery, which is nearby.

J. Environmental

1. How do I diagnose an allergic reaction? How do I treat it? What is the difference between anaphylaxis and just an allergic reaction?

Allergic reactions occur when the body's immune system reacts to something in the environment and what you see in the patients are the results. Allergic reactions are on a spectrum – at one end is a runny nose or itchy eyes and at the other is anaphylaxis – a body wide reaction, involving a wide spread rash with difficulty breathing or a low blood pressure and shock.

Minor allergic reactions:

At this end of the spectrum we see:

Allergic conjunctivitis – itchy red and perhaps tearing eyes and/or
A runny nose and facial congestion (hay fever) and/or
A localized itchy raised rash – hives or welts – generally localized to an area of the body, but sometimes all over.

The trigger may be known to the patient or may occur out of the blue – common allergens include pollen, pine resin, or cat or dog fur.

Treatment is relatively simple – although not always effective – remove the patient from the allergen if it's known – a cool shower is often helpful. If available, an oral antihistamine like Loratadine or Benadryl should be administered – usually one to two doses is enough. If facial congestion symptoms predominate, a decongestant nasal spray is useful if available.

Patients with bad symptoms (but of mild severity) may benefit of a short course of steroids – Prednisone tablets 40mg once a day for 3 days.

Some people experience seasonal hay-fever or allergic symptoms every year – like any chronic disease or problem it is worth preparing for this by stocking up on decongestants and antihistamines.

Severe allergic reactions (anaphylaxis):

Anaphylaxis is an allergic reaction involving the whole body i.e. its generalized and it may present as difficulty breathing, noisy breathing or shock. Exposure to an allergen (something the patient is allergic to) results in the release of inflammatory mediators from mast cells and basophils which cause the signs and symptoms of anaphylaxis. While there are a number of mediators, histamine is the most widely recognized.

Patients who have been stung, but only have a localized reaction – redness, swelling or pain, do not have anaphylaxis.

Triggers:
About 40% of the time the patient has a known allergy
In patients who develop anaphylactic reaction – 25% it is due to bites and stings, 25% is due to food allergies, 25% is due to medications and 25% is a catch all category where the thing causing the reaction is not known or it is due to something else.

Recognition of anaphylaxis:
One of the most important things about anaphylaxis is to think of it as a possible diagnosis with someone who presents as suddenly sick.

Classically to diagnose anaphylaxis you need the following:

1. An extensive raised, red, raised rash – welts or hives **AND**
2. Shortness of breath, difficulty in breathing or wheeze **AND/OR** signs of poor perfusion, a low blood pressure, or episodes of fainting.

It is possible to make the diagnosis without the rash (15-20% - have no rash or a very short lived rash) that requires **two** of:

1. Shortness of breath, difficulty breathing, stridor – noisy breathing when inhaling **OR**
2. Signs of poor perfusion, a low blood pressure, episodes of fainting or feeling like you are going to faint. **OR**
3. Cramping abdominal pain, feeling sick, vomiting or sudden heavy diarrhea.

Management of anaphylaxis:
Anaphylaxis can be life-threatening and delays to treatment can be fatal.
The treatment is with an injection of adrenaline (UK.Aust.NZ name)/epinephrine (US.Canada.South America name). There are two approaches:

i. An Epi-pen/Aanpen – these are adrenaline auto-injectors – the person can inject themselves with adrenaline if they experience an anaphylactic reaction. The adult auto-injector will inject 0.3mg into the muscle and the child auto-injector will inject 0.15mg of adrenaline. These are the standard adult and child doses for a patient with adrenaline. 50% of patients will require a second dose of adrenaline. If storing epi-pens, a minimum of two are required.

   A recent study has also demonstrated epi-pens retain their effectiveness and remain safe for several years following their expiry date.

ii. Adrenaline in an ampoule. Generally, these are 1mg ampoules. A patient with anaphylaxis requires 0.3-0.5mg (so 0.3-0.5mls) of adrenaline to be drawn up and injected in the big muscle of the front of the front of the thigh. Children over 5 should be given the adults dose, children under 5 should be given 0.15mg (0.15ml). If the patient is not improving then the dose should be repeated every 15 minutes until stable – in some patients 5 or more doses are required – but that is in the minority.

In patients who are very unwell intravenous adrenaline is an option – this is riskier and generally provides little benefit over IM adrenaline – the exception being severe shock – where the IM adrenaline might be poorly absorbed. The safest way to administer intravenous adrenaline if the equipment is available, is to place 1mg of adrenaline in 1000mls of normal saline – running it in slowly and adjusting the flow rate to how quickly the patient gets better – settles quickly = slow down and stop. Not settling or deteriorating = speed up rate of infusion. In the absence of IV fluids to make an infusion, the 1mg of adrenaline can made up in a 20ml syringe and 1ml (25 micrograms) given as IV push every 2-3 minutes until patient gets better.

If no adrenaline is available and salbutamol/albuterol inhalers are, consider utilizing these especially if respiratory symptoms predominate.

If the patient is shocked, intravenous (or SC or Rectal – both of which are likely to be relatively ineffective in anaphylaxis) fluid administration should be considered – often several liters are required to treat the shock

Despite their widespread use, there is no evidence that antihistamines or steroids reduce the severity, speed up the resolution, or prevent anaphylaxis occurring again. The management of anaphylaxis is adrenaline/epinephrine and fluids.

Prompt recognition and management of anaphylaxis can be lifesaving.

3. How do I treat hypothermia?

While you live for seconds without air and a few days without water, you will only live for minutes or tens of minutes without shelter.

There are four primary methods of heat loss – by understanding these you can minimize them:

- Convection: heat is carried away from the body by currents of air or water. Wind chill is an example of convection.
- Conduction: is the transfer of heat between two contacting surfaces. Water conducts heat 25 times faster than air and steel is even faster than water – one 'sucks the heat' from the other.
- Evaporation: heat loss due to the energy used to change water to vapour. Examples of this are sweating and respiration.
- Radiation: is the loss of heat from a warm body to a surrounding colder environment. Radiative heat loss is significant on cold, cloudless nights.

As the body cools we see a reliable pattern of clinical features:

- 37°C (98.6°F) Normal oral temperature
- 36°C (96.8°F) Metabolic rate increased
- 35°C (95°F) Maximum shivering seen/impaired judgment or decision making
- 33°C (91.4°F) Severe clouding of consciousness
- 32°C (89.6°F) Most shivering ceases and pupils dilate
- 31°C (87.8°F) Blood pressure may no longer be obtainable
- 28~30°C (82.4~86°F) Severe slowing of pulse/respiration rate. Increased muscle rigidity
    - Loss of consciousness
    - Potential for ventricular fibrillation – a chaotic heart rhythm not producing a pulse.
- 27°C (80.6°F) Loss of deep tendon reflexes and capillary refill
    - Patients appear clinically dead
    - Complete cardiac standstill

We consider hypothermia in 4 broad clinical groups:

Impending Hypothermia: These patients have started to cool for whatever reason – most environmental, but occasional due to a physiological or medical reason their temperature has dropped to 36˚C (96.8°F). By most definitions, it is not technically hypothermia – but the patient is on the slippery slope.

If it is possible for them the person will increase activity to try and warm up themselves. The skin may become pale, numb and waxy. Muscles become tense, shivering may begin but can be overcome by activity or focus.
Fatigue and signs of weakness may begin to show.

Mild Hypothermia: The person now has hypothermia. The core temperature has dropped to 35 - 34˚C. (95 - 93.2°F.). Uncontrolled, intense shivering begins and cannot be overcome by mental focus. The patient is still alert, however movements become less coordinated and the patient will often complain of feeling cold.

Moderate Hypothermia: The patients core temperature has now dropped to 33 - 31˚C. (91.4 - 87.8°F.) The shivering slows or stops, muscles begin to stiffen and the patient begins to become confused. The patient also becomes apathetic. This often manifests itself as a lack of ability to help themselves – they know what needs to be done, but don't do it. Their speech becomes slow and slurred, breathing becomes slower and shallow, and drowsiness and strange behaviour may occur.

Severe Hypothermia: The patients core temperature is now below 31˚C. (87.8°F.)The skin is cold and may be bluish grey in colour. The eyes may be dilated. The patient is very weak, displays a marked lack of coordination, slurred speech, appears exhausted, may appear to be drunk, denies problem and may actively resist help. By this stage, the conscious state is usually markedly reduced. Often, they are unresponsive or only responsive to pain. There may be no obvious respiratory effort and the patient may appear dead.

Management of hypothermia:

The goal is slow rewarming. We need to aim for 1˚C. (1.8 degrees F.) an hour

Mild – Mod hypothermia:

- Warm dry clothes
- Blanket
- Warm ambient temperature
- Skin to skin warming
- Warm (not hot) bath

Severe:
Above + Warm IV or rectal fluid if available.
If cardiac arrest in an austere setting:

- ❖ Consider CPR + rewarming if the patient cooled quickly – for example if they were out in the snow or in a river with glacial run off.
- ❖ The outcome without critical care support = dead
- ❖ Resuscitation is resource dependent – if you can provide advanced airway care and have access to a defibrillator and the manpower, then a period of resuscitation it is reasonable to continue resuscitation if possible for several hours as you warm them up.

4. I have a patient who has been out in the bush in wet cold boots for the last few days and her feet look awful. What is it?

It is likely they have an immersion injury (or trench foot). This occurs when an extremity (usually feet) are exposed to a cold wet environment for a prolonged period.

Clinical: The main complaint from the patient is pain. The skin looks white and macerated. The capillary refill is delayed and the pulses may be weak and thready.

Treatment: Wash and clean the feet. Dry and warm them, but do not expose to direct heat. The patient should be encouraged to stay off their feet and keep them elevated.

5. How is frostbite different from immersion foot? Do I treat it differently?

Yes, it is. Immersion injury is where the feet or hands get wet and soaked in cold water. Frostbite is where the extremity gets frozen – it may be just a superficial layer of skin or it may be the whole extremity but tissues freeze. As the tissues freeze, ice crystals form within and water is drawn out of the

cells into the extracellular space. These ice crystals expand causing destruction of cells. It starts to occur when tissues are exposed to a constant temperature of < 2 degrees C. (35.6 degrees F.).

Some predisposing factors include:

- wet skin
- extreme wind chill
- constricting garments
- contact with cold metal
- individuals with altered mental status who are unable to get out of the cold

There are two types:

Superficial injury (affecting the dermis and shallow subcutaneous tissue): Superficial injuries are characterised by numbness, tingling of affected areas, pain, the area is bright red and warm to touch. Rapid swelling, blistering of part and a superficial eschar (blackening of top layer of tissue= tissue death).

Deep injury (affects the dermal and deep sub-dermal tissues): The affected area takes on a deep purple/congested colour. The area is cool to touch**,** small bleeding blisters present and slow swelling occurs.
Slowly over weeks to a couple of months, mummification of deep structures occurs. It can take several months to determine if tissues will die or heal – so while amputation is often required, it should not be done early.

Management:

The most important rule is to not thaw the affected area. Do not rub (it increases the pain and doesn't help.)

- ❖ Analgesia – frostbite hurts. Frozen tissues don't hurt, but as blood flow returns they can become extremely painful.
- ❖ Cover the affected area, do not "break" blisters.
- ❖ As described above, wait and see, it may take weeks to months for you to be able determine if tissues are alive or dead. Amputation should not occur for several months unless signs of systemic (body wide) infection occurs sooner.

6. I have a patient who has been out in the snow and now has painful red eyes?

They all most certainly have snow blindness. This is a UV light burn to the cornea. It is like "arc eye" from welding. Clinically, they have severe eye pain (usually both eyes), lots of tearing and difficulty opening eyes.
The treatment is pain relief (NSAID are good) and cold eye baths. It usually settles over 24-48 hrs.
Prevention: proper sunglasses (UV-proof), or makeshift goggles with narrow eye slits to reduce glare.

7. How do I treat hyperthermia?

Hypothermia (cold temperature) is cold, hyperthermia (hot temperature) is hot, heat illness is a spectrum. For most patients, the cause of the hyperthermia is either a hot environments or extreme exercise in warm environments – these patients account for the clear majority of patients you are likely to encounter. However, it is worth noting that a variety of medical problems can also cause hyperthermia: delirium tremens – alcohol withdrawal, certain drug overdoses, some endocrine disorders (e.g. hyperthyroidism, diabetes) and some neurologic diseases (e.g. autonomic neuropathies, Parkinsonism, dystonia)

Heat illness is a spectrum. At one end we have heat stress – where the body is just uncomfortable due to the environmental temperature, towards the middle is heat exhaustion where the person is becoming physiologically unwell due to the heat and at the other end is heat stroke where the body is losing its ability to regulate its temperature and is taking on the ambient temperature. A patient can present anywhere across the spectrum and will not automatically fit in a box- it is a continuum.

Heat stress/cramps
Classically present with an increased HR, possible nausea and vomiting, they are hot and sweaty. They may feel faint or complain of dizziness or tiredness. They complain of muscle cramps or pain. Important that they have a normal temperature and blood pressure.

Heat exhaustion
Heat exhaustion is an acute heat injury with hyperthermia due to dehydration.
It occurs when the body can no longer dissipate heat adequately because of extreme environmental conditions or increased endogenous heat production.
It may progress to heat stroke when the body's thermoregulatory mechanisms become overwhelmed and fails.

Signs and symptoms of heat exhaustion include: headache, profound weakness or fatigue, dizziness, loss of appetite, nausea, vomiting, profuse sweating, dilated pupils, a weak and rapid pulse and rapid, shallow breathing. The patient may be hot / febrile – but not excessively so – 38-39 degs. C. (100.4-102.2 degs. F.).

Heat stroke
Heat stroke is at the extreme end of the hyperthermia spectrum and is associated with thermoregulatory (control of body temperature) failure within the brain itself. The condition is characterized by serious organ damage, the diagnostic feature is the involvement of the brain – loss of control of blood pressure and acute confusion or loss of consciousness.

Heat stroke is traditionally divided into **exertional** and **classic varieties**, which are defined by the underlying cause but they are clinically indistinguishable from each other. Exertional heat stroke typically occurs in younger athletic patients who exercise vigorously in the heat until the body's normal thermoregulatory mechanisms are overwhelmed and collapse. Classic heat stroke is more common in older patients or in patients with underlying illnesses who are exposed to extreme environmental conditions – but the disease triggers the illness.

Signs and symptoms are like heat exhaustion, but the brain findings are more pronounced – dilated pupils, headache and confusion, loss of consciousness and seizures. Because of loss of control of temperature regulation, the patients temperature may be 41-42 degrees C. (105.8-107.6 degrees F.).

Treatment of heat emergencies

The single most important action is to remove the patient from the hot environment and transfer to a shady place. If you have access to a car – place in the car with AC running full blast and parked in the shade.

Support the patients A,B,C – open their airway and administer (ideally) intravenous fluids – but oral, rectal or SC are ok. Start cooling measures with any resources available. Cold/wet sheets placed over the entire body + fans to circulate air over the patient. Ice packs in the groin, arm pits and on the neck.

Heat stroke is can be rapidly fatal and the body temperature must be bought down to below 40 degrees C. (104 degrees F.) as soon as possible

8. How do I deal with a snake bite?

The short answer is it depends where on the planet you are. Venomous snakes are broadly classified as elapids (in tropical or subtropical areas – Australia, Africa, Parts of Asia) or crotalids (commonly known as pit-vipers and located in Europe, Asia and both North and South America).

Australia and Africa

These are usually elapidae species. The clinical presentation depends on the snake:

- ❖ Coagulopathy – has the potential for uncontrollable bleeding
- ❖ Paralysis – which is usually generalized but effects small muscles first → breathing muscle.
- ❖ Muscle damage – the venom causes the muscles to break down causing kidney failure.

Regarding common snakes, generally venom causes:

- Brown snakes: coagulopathy and paralysis.
- Taipans: muscle damage, coagulopathy and paralysis – difficult to reverse, even with antivenom.
- Tiger snakes: coagulopathy, muscle damage, paralysis – difficult to reverse.
- Death adder: paralysis which tends to wear off
- Black snakes (Including mulga or “King Brown” snake): muscle damage and coagulopathy.
- Sea snakes: mostly paralysis, some muscle damage.

Treatment:

Prevention is the best cure by far:

- Don’t play with snakes

- Long trousers, high boots in outdoor areas
- Don't stick your hand into dark hollows

Early first aid consists of application of a pressure immobilization bandages (a firm, but constricting crepe bandage applied from the bite site up the limb) and splinting the limb. The goal of the pressure immobilization bandage is to stop lymphatic fluid moving up the limb – venom moves in the lymphatic fluid.

example of pressure immobilizing bandage

In an austere situation, additional austere care would include:

Supporting breathing including the use of an LMA + ventilation. Paralysis could last several days so the ability to ventilate is important. Some cases the paralysis is permanent and fatal

Supporting circulation, treat shock with IV, SC or rectal fluids

Anti-venom is unlikely to be available in an austere situation. In its absence, leave pressure immobilization bandage on for 48-72hrs (slows movement of venom). Theoretically this allows the breakdown of venom over time. There is possible value in heating the limb to >40 degrees C. (104 degrees F.) with hot-packs for several hours – this denatures protein in venom, check the distal circulation in limb frequently.

America

If you are in the U.S. and you come across a venomous snake it will almost certainly be of the crotalid family, which are most commonly known as "pit-vipers". These snakes have a triangular shaped head which contains a heat-sensing pit that is used for hunting. All pit-vipers are venomous, though the strength of the venom varies among species.

They carry venom in a set of glands and can control its release. This is important to remember, as up to 25% of snake bites to humans are "dry bites", meaning that the snake did not inject venom when it bit.

The pit vipers use a rapid bite with a set of long, flexible fangs to inject venom into their prey, which differs from elapid snakes. Elapids have short, fixed fangs and tend to use a chewing motion when biting.

There are several species of coral snakes found in the southern United States. The snakes are very shy, though, and rarely bite humans. As an elapid, their venom is highly toxic and can be deadly. If you are in Louisiana, Florida, or Southern Texas, Arizona, Georgia, Alabama or Mississippi, or coastal North and South Carolina, you might be on the lookout for coral snakes. The adage "red on yella, kill a fella; red on black, venom lack" that describes the red/yellow/black color patterns holds true for North American coral snakes MOST of the time.

As mentioned previously, the best treatment is prevention. Stay inside after dark or carry a light when outdoors. Most of these snakes are nocturnal hunters and rarely found during the daytime. Watch where you step or put your hands. Listen for a warning rattle if you get too close to a rattlesnake or even a copperhead as it tries to mimic the rattlesnake. Cottonmouths are semi-aquatic and can be found in the daytime on the water or sunning nearby in a tree or on a rock. Currently, most reported bites in the US occur when someone is trying to kill or attack the snake. Grid down—just leave them alone!

Broadly, there are four families of venomous snakes in the US.

- Cottonmouths
- Copperheads
- Rattlesnakes
- Coral snakes

While similar in terms of genetics and type of venom they are importantly different in several regards.

1. Cottonmouths– intermediate potency venom; can be aggressive if provoked. Swim on top of the water, unlike nonvenomous water snakes.

2. Copperheads – least potent venom and negligible mortality rate; shy and, typically non-aggressive. Responsible for the largest number of bites annually. Bites cause local tissue destruction.

3. Rattlesnakes – have a relatively potent venom; the aggressiveness varies by species. Rattlesnakes can be found in all lower 48 states. Their bite can leave a nasty wound and cause systemic toxicity. The Mojave Green is an exception as to potency, having an extremely potent venom.

4. Coral snakes – have the most potent venom but are the least aggressive. Their bite causes respiratory failure due to blocking the nervous system

For the most part, a pit viper snake bite will be immediately painful followed by rapid swelling within 5-10 minutes. Tingling or numbness may be felt on the face, scalp or extremities 30-90 minutes later. Nausea, vomiting and fainting can occur after 1-2 hours. Many victims report a rubbery or metallic taste in the mouth later on. Swelling and discoloration of the limb will begin to spread.

Coagulopathy (thinning of the blood) and muscle damage are common with all but the coral snake and Mohave Green. The former is neurotoxic (nerves and central nervous system) and the latter is both hemotoxic (damage to blood cells) and neurotoxic.

Onset of symptoms in coral snake bites is often 4-6 hours, but can take up to 12. Although it possesses the most toxic venom of the US snakes, death is from a coral snake bite is very rare, likely owing to the rapid use of antivenin, and the small quantity of injected venom per bite.

Most deaths are caused by eastern and western diamondbacks rattlesnakes.

If you get bit-

1st- STAY CALM!
2nd- Move away from the snake to avoid getting bit again.

Then, look at the snake to see if you can identify it. A light pressure bandage and/or splint can be applied to help immobilize the limb. Remove any potentially constrictive jewelry or clothing before the swelling spreads. You may use a marker to outline the edge of swelling and note the time – repeat this frequently to monitor and track the swelling.

In the absence of emergency care and availability of antivenin, treatment for a snake bite victim is largely supportive. The toxin simply must run its course. Depending on the species of snake, your patient can expect a two week to several month-long recovery times. Pain medication is certainly indicated, as is the initiation of antibiotic therapy.

On some occasions the tissue destruction is large with extensive damage – in an austere situation in some cases the only safe option is amputation of the limb – particularly if a secondary infection develops. However, it will take (like with frostbite) weeks to months to demarcate and for tissue death to be absolutely clear.

Of the recommendations for snake bite victims, perhaps the most important to know is what to avoid.

DO NOT –

- Cut or incise the bite
- Apply ice
- Use a “stun gun” (electric shock) on the bite
- Drink alcohol or caffeine
- Apply a tourniquet or constrictive band

Over time these methods have proven ineffective and, at times, cause more damage. Remember “first, do no harm”.

The use of a Sawyer venom extractor is controversial. There is no real evidence that it removes venom from the bite but no evidence that it can cause further damage. So, in an austere setting, you may opt to have one at hand and if you decide to use it, do so immediately to increase the chance of removing the venom. At the very least, it can give the impression that you are doing something proactive to help the situation rather than just telling the victim to stay calm. Consider it the placebo effect of snake bites.

Applying the Australian type immobilization bandage is not recommended in pit-viper bites. The logic is that pit-viper venom is more locally destructive than elapids and restricting the venom to one area only increases local tissue damage at one site.

K. Miscellaneous

1 I only have tablets or capsules of a medication and the patient is unconscious. What do I do?

Tablets or capsules can be given via a nasogastric tube (NGT) if one is available – capsules can be opened and sprinkled into a small volume of water and administered down the tube. Some tablets can be crushed in a small volume of water and administered in the same way.

If the use of a NGT is not available then the tablets can be crushed into a paste and the capsules mixed into a paste, and that paste can be smeared on the patient's gums. The absorption by this method will not be perfect, but will be better than nothing.

2. Should I learn how to use homeopathy/naturopathy/ reflexology/essential oils?

There is a huge spectrum of alternative therapies and associated practitioners. For the majority, there is very little evidence aside from anecdotal to their efficacy. A common underlying principle of most alternative therapies is good nutrition and a healthy lifestyle – the value of this is clearly not in dispute. How much of the remainder you choose to accept is a personal decision. A few alternative therapies are based on scientific theories from hundreds of years ago which have been superseded by modern science. To accept these underlying principles requires you to suspend your belief in some of the fundamental concepts of modern science, especially physics. Note we have specifically excluded herbal and botanical medicine here, and this is discussed in Chapter 21

It is vital you should take the time to look at the evidence for an alternative therapy or diagnostic modality before counting on them as a main part of your medical preparations. The weakest sort of evidence is anecdote and testimonials, and you should be very careful accepting any therapy that only has this level of evidence to support it. Also, be aware of any therapy that claims it is too "special" or personalized to be submitted to the rigors of randomized controlled trials (RCT). The RCT is by no means a perfect way of assessing efficacy, but currently it is the best we have and the standard to which all medical therapies – conventional or alternative - should be held. However, a degree of common sense needs to be applied as well. Conventional medicine does not have trials proving every therapy works and neither should alternative therapies by expected to either. Some things we intuitively know are correct – you do not need a randomized controlled trial to prove that a parachute is better than nothing if you are about to jump out of a plane. The caveat to this statement is "that the rationale as to why a therapy works should make sense and not involve the suspension of the laws of physics, well known physiology or an acceptance of the supernatural to be able to accept it".

Always remember, is the advice designed to help you, or to sell you something you don't need?

Colloidal Silver (CS)

CS is deserving of special mention because it is widely discussed in preparedness circles and many have a reliance on it for its antibiotic properties in their preparations. There are many anecdotes about how effective CS is in treating a huge range of bacterial, viral, and fungal infections, and many people have personal experience of its effectiveness.

Colloidal silver is silver atoms in solution, grouped together in clusters – essentially metallic silver in suspension – in an uncharged, non-ionic form.

Ionic silver has extensive antibacterial properties in the laboratory setting. There is a large body of evidence showing silver compounds (which release ionic silver) are effective topical antibiotics particularly in burns, chronic skin infections, and ulcers. There is no evidence that silver compounds are effective with systemic infections i.e. an infection inside the body.

CS is metallic not ionic silver. There is no evidence that colloidal silver is an effective antibiotic. Many websites make claims about the effectiveness of CS as an antibiotic, and one at least grossly misrepresents research which has been done.

The following articles should be read by anyone with a serious interest in CS:

1. D. L. Bowen & M. C. Fung, "Silver products for medical indications: risk-benefit assessment." J. Clin. Toxicol.1996; 34(1):119-126.

2. Moyer, et al; "Treatment of Large Human Burns with 0.5% Silver Nitrate Solution." Arch. Surg. 1965 Jun; 90 pp 812.

3. Lansdown, A.B. “Silver: Its antibacterial properties and mechanism of action.” J Wound Care. 2002 Apr; 11(4):125-30

CS is associated, if used frequently and in large amounts although exactly how much is an individual thing, with the development of Argyria (disposition of silver in the tissues) which is a grey or blue discoloration of the skin, mucus membranes, and/or finger nails. This is not considered to be a serious condition, but the changes are irreversible. There is wide spread belief that this does not occur with CS, but only with silver compounds. However, there are now many case reports – mostly in the dermatology literature of this condition in patients using commercial or homemade CS. One of the contributing authors has seen this.

In summary, there is no evidence that colloidal silver works as a broad-spectrum topical or systemic antimicrobial, and given what we know about how silver produces its antimicrobial effect we have no reason to think that at a molecular level it would work. This does not mean that it doesn’t, but the absence of good evidence makes it less likely. The only way to know with any certainty is a RCT, however, it is unlikely that there will ever be any large-scale trials as such trials are expensive, and there would be no profit in one.

It is very popular and a lot of people have placed a great deal of faith in it. It is a risk/benefit situation – if you choose to rely on CS then you need to be aware of the lack of evidence and the real possibility that it does not work over and above the placebo effect.

3. What is the "Placebo Effect"? Is it bad?

The “placebo effect” refers to the fact that for any therapy a percentage of people will respond (it ranges from 0-30% depending on the therapy), and show a benefit that is not related to any pharmacological effect of the drug, and this benefit persists when a sham therapy is substituted for the real one. This effect is important in both conventional and alternative medicine. Despite the negative connotations associated with it, the placebo effect is a **VERY GOOD** thing.

It is important to be aware of this in an austere situation – not so much for you but for your patients. If you present yourself to the patient with confidence, and prescribe a therapy with confidence and conviction a significant number of patients will show improvement even if you are only giving them a sham therapy – such as an alcohol based tonic – the value of this in a survival situation shouldn’t be underestimated. The body is vastly more complicated than what we currently understand and despite its negative press if the placebo effect of a specific therapy helps people get better and is otherwise harmless (that’s a very important proviso) then it is potentially useful.

Chapter 8: Infectious Disease and Antibiotics.

An infectious disease is caused by one of many "germs", including bacteria, fungi, viruses and parasites. Some can be spread between humans either directly through contact (touching, kissing, etc.) or indirectly (sneezes, touching a contaminated surface). Antibiotics are a medication that have been developed to treat bacterial disease, either by killing the bacteria or preventing their replication.

Infectious disease causes a huge burden of disease in man and even now kills many millions of people a year. Prior to the invention last century of antibiotics, infectious disease was an even bigger killer and simple things like sore throats or a minor wound infection could kill.

To understand infectious disease, you need to understand not only the clinical presentation of a disease, but more broadly you need to understand the basic science of microbiology and antibiotics.

Antibiotics are one of the most talked about subjects in austere and survival medicine, but this is an area where there is widespread misinformation and ignorance. There are multiple different antibiotics and they work best depending on the bacteria causing the infection and the location of that infection. What follows is an overview designed to give you a better understanding of what works for what.

Antibiotics only work in bacterial infections and in some parasitic infections. They don't work in treating viral infections, which accounts for the clear majority of coughs, colds, flu's, earache, sinus, and chest infections, which people suffer from every winter. While there are some specific antiviral medications, most viruses do not have a specific drug to treat infections caused by them.

There is no one antibiotic that works in every situation and giving the wrong antibiotic can be worse (long-term) than not giving one at all. Each organism has one or two antibiotics that are specific for that organism and that is the antibiotic, which should be used – not any old one which happens to be lying around!

Lastly, it's important to state that some of the antibiotic advice given here is pragmatic as opposed to the optimal or best practice – there are 30-40 different antibiotics or variation of them – here we only address the 10 or so most common or important ones. It is impossible to store and rotate 40 different types of antibiotics and realistically 10 or so antibiotics covers most clinical situations, but while these may be an adequate and safe antibiotic to use, they may not be the "best" – the motto of Survival Medicine is pragmatism.

Bacteria:

Bacteria are small, single cell organisms that are found in abundance everywhere in our environment. There are hundreds of millions of different species of bacteria; most do not cause illness in man. You will find good bacteria on the surface of your skin—by living there, they prevent bad bacteria from

overgrowing and causing skin infections. Good bacteria thrive in your gut, as well. It is when bacteria gain entrance to a wound or when they are inhaled or eaten that humans become ill from them.

There are four main classes of bacteria
- Gram-positive (Gm + ve)
- Gram-negative (Gm - ve)
- Anaerobes
- Others

Gram-positive bacteria stain blue and gram-negative bacteria stain pink when subjected to a gram-staining test. They are further subdivided by their shape (cocci = round, bacilli = oval) and if they form aggregates or not. This is described in much more detail in the Field Laboratory Chapter 15.

Anaerobic bacteria are ones that require no oxygen to grow.

Gram-Positive Bacteria (Gm +ve):

- Staphylococcus: The most common pathogen is S. aureus; Gram-positive cocci in clumps. Staph is found commonly on our skin (in moist hot areas like arm pits and groin) and in our noses. Causes boils, abscesses, impetigo, wound infections, bone infections, pneumonia (uncommonly), food poisoning, and septicaemia. In patients who develop septicaemia it can seed to the heart valves or spinal cord. Generally, they are very sensitive to Flucloxacillin as first choice drug, and Augmentin or a cephalosporins as an alternative. World wide resistance to penicillin-based antibiotics like Fluclox and Augmentin is increasing.

  A strain which is resistant to the above antibiotics is known as MRSA (Methacillin resistant Staphylococcus aureus) is currently treated with vancomycin or TMP-SMX.

- Streptococcus: Gram-positive cocci in pairs or chains. Most are not pathogenic in man except Strep pneumoniae and the Strep pyogenes. Strep pneumoniae causes pneumonia, ear infections, sinusitis, meningitis, septic arthritis, and bone infections. Strep pyogenes causes sore throats, impetigo, scarlet fever, cellulitis, septicaemia,and necrotising fasciitis. Streps are usually very sensitive to penicillins, cephalosporins, and the quinolones.

Gram-Negative Bacteria (Gram -ve):

- Neisseria meningitidis: Gram-negative cocci in pairs. Common cause of bacterial meningitis, may also cause pneumonia and septicaemia. Can be rapidly fatal. Sensitive to penicillins, cephalosporins, quinolones, Co-trimoxazole, and tetracyclines.

- Neisseria gonorrhoeae: Gram-negative cocci in pairs. Causes gonorrhoea. Sensitive to high dose amoxicillin (single dose), Augmentin, and also cephalosporins, and quinolones.

- Moxella catarrhalis: Gram-negative cocci in pairs. Common cause of ear and sinus infections, also chronic bronchitis exacerbations. Sensitive to Augmentin, cephalosporins, quinolones, Co-trimoxazole, and tetracyclines.

- Haemophilus influenzae: Gram-negative cocci-bacilli. Can cause meningitis (esp. in children under 5), epiglottitis, cellulitis, and a sub group causes chest infections. Sensitive as M.catarrhalis.

- Escherichia coli: Gram-negative bacilli. Normally found in the bowel. Causes urinary infections, severe gastroenteritis, peritonitis (from bowel injury), and septicaemia. The antibiotic of choice has traditionally been a quinolone or cephalosporin. However E.Coli is becoming increasingly resistant to both (although in many areas they work fine – that is why it is important to understand local resistant patterns which can be obtained from the microbiology labs at your local hospital).We recommend Co-trimoxazole as a first choice – especially for urinary tract infections.

- Proteus species (sp).: Gram-negative bacilli. Lives in the bowel. Causes Urinary tract infections (UTI's), peritonitis (from bowel injuries), and wound infections. Drug of choice is the quinolones.

Anaerobes:

- Bacteroides sp.: Gram-negative bacilli. Normal bowel flora. Commonly causes infections following injury to the bowel, or wound contamination, causes abscess formation. Treated first choice with metronidazole or second with chloramphenicol or Augmentin. Chloramphenicol is moderately high risk with high doses (>4gm/day) causing bone marrow suppression which rarely can be fatal – but it is cheap, readily available, and complications are rare. Metronidazole and cefotaxime IV combination is good for Bacteroides fragilis. Zosyn or imipenem is a good single agent therapy.

- Clostridium sp.: The Clostridium bacteria are easily found in the soil and gut, and can survive for long periods of time in the environment. This is important to remember when considering the diseases they cause. They are a gram-positive species produce spores and toxins:

  I. *C. perfringens/C. septicum* - common cause of gangrene; treat with penicillins or metronidazole
  II. *C. tetani* – tetanus damage is from toxins, not the bacteria themselves.
  III. *C. botulinum* – causes botulism. Again, disease is from toxins produced by the bacteria.
  IV. *C. difficille* - causes diarrhoea following antibiotic dosages; treat with metronidazole

  Botulism is one of those scary diseases you hear about people contracting from eating home canned food. It causes muscle weakness leading to flaccid paralysis and death. The risk comes when canned food is not processed properly to kill the botulism spore and its toxin. To protect yourself, you can boil home canned foods, even if they do not appear to be spoiled. Botulism is discussed in more detail in the Clinical FAQ chapter.

Tetanus is most commonly acquired after a wound gets contaminated with dirt or, also in an austere environment, when a surgical procedure is attempted with improperly sterilized instruments. Tetanus causes "lockjaw", muscle stiffness and rigid paralysis. A vaccine is available for tetanus and should be sought out if at all possible.

In a collapse scenario, by the time tetanus or botulism is suspected there will no treatment available. Both diseases lead to paralysis of the diaphragm (breathing) muscle and without assisted ventilation, those affected will die.

Others:

- Chlamydia species: Includes C. pneumonia; responsible for a type of atypical pneumonia and C. trachomatis; responsible for the sexually transmitted disease Chlamydia. It is best treated with tetracyclines or as second choice a macrolide.

- Mycoplasma pneumoniae: A cause of atypical pneumonia. Treated best with a macrolide, second choice of tetracycline.

Viruses:

Viruses are small infectious particles – they are really just little sacks of genetic material, which borrow their hosts cells to reproduce. They are very small and cannot be seen with a traditional light microscope. There are a variety of species of viruses which are classified according to who they infect - plant viruses, animal viruses, and even viruses that infect bacteria and parasites. The nature of viruses are such (they reproduce by using the hosts cells) that at a fundamental level they always cause harm to the host, but this is a spectrum from minor to severe depending on the virus.
.
Viruses are classified by if their genetic material is DNA or RNA and how they are shaped and the nature of their envelope of proteins.

Examples include: The Hepatitis's family – A,B,C, Smallpox, Polio, Chicken pox, Herpes, Measles, Mumps, HIV and Influenza.

Over the last 25 years there has seen the development of a number of "antivirals" to treat viral infections. However, because viruses replicate inside their host's cells, it is difficult to selectively kill virus cells without killing host cells. Antiviral drugs must be given very early in a disease and most reduce the severity of illness and limit infection rather than act in a curative way, they way that antibiotics do with bacterial disease. Vaccination prior to infection appears to be the way forward and effective vaccines now exist to many viral illnesses that previously had high mortality or serious complications like Polio, mumps or Hepatitis B.

It is a common misconception among many people that antibiotics can cure viral infections and this is both wasteful of antibiotic, but also encourages resistance.

Fungi:

Fungi are a large family of complex single cell (such as yeasts) or multi cellular organisms (such as mushrooms). In contrast with viruses their cells have all the required components to reproduce and they share the common feature of the ability to form spores as part of their reproductive process. Only a few cause disease in humans.

That is usually due to direct infection of the skin (such as ring worm or athlete's foot), the vaginal or oral mucosa (such as thrush) or lung infections when the reproductive spores are inhaled (such as histoplasmosis). They rarely cause more serious infections in man – however in patients who are immune-compromised (such as HIV/AIDs) this can occur.

Again like with viruses, antibiotics are of no use against fungi – however it is common for "good" bacteria to sometimes contain the growth of fungi and if these good bacteria are accidentally killed by antibiotics fungal overgrowth can occur, such as in vaginal thrush where the death of normal vaginal lacto-bacteria can lead to over growth the candida fungus.

However a number of specific antifungal medications are available which can be applied topically onto the skin, such as Clotrimazole or taken orally such as Fluconazole.

Protozoa:

Protozoa are complex microorganisms – they are single celled organisms in the same way that bacteria are, but at the cellular level they are much more complicated (with a nucleus and mitochondria) and are usually bigger. A common but not universal trait is flagella – a little tail which is used to help with movement.

Like fungi, most do not cause disease in man. Examples include Giardia (causing an infectious diarrohea), Trichomonasis (causing a vaginal infection in women) and Malaria.

With anti-protozoal agents there is some cross over between agents also used for bacteria. The classic example of this is Metronidazole which works for anaerobic bacterial infections as well as for protozoal infections like Giardia and Trichomonasis.

Parasites:

Parasites are organisms, which attach themselves to a host for their own gain and cause harm to host. Technically bacteria, fungi, viruses and protozoa all fit this definition – however generally when we talk about parasites we are talking about protozoa or larger more complex organisms such as worms or fleas or lice. Generally speaking, the more cells the organism has, the harder it is to kill without harming the host – because cells in humans are similar to cells in many parasites in order to kill them agents we use to kill parasites potentially can harm the host (us) as well and more care is required with the agents we use – and we see this is the case with the treatments we use for parasites like worms and lice. Parasites can also carry bacteria which can then subsequently cause disease in humans – plague (caused by

Yersinia pestis) is a good example of this, where fleas are minor and irritating parasitic infection, but can carry Yersinia and when they bite humans potentially transmit plague to them.

Antibiotics

Prior to discussing how each antibiotic works and what clinical situation it is most useful for, it is important to discuss some broad principles, which have implications for antibiotic use – resistance, spectrum of activity, use in pregnancy, use of veterinary antibiotics and antibiotic allergy.

Most western countries have their own antibiotic handbooks or references which are written taking account of local availability, sensitivities and preferences.

USA	The Stanford Guide
Australia	Therapeutic Guidelines Antibiotic manual
UK	British National Formulary

a. Resistance

We define resistance as reduced effectiveness of a drug against bacteria—i.e. the bacteria continue to replicate even when the antibiotic is there to kill them. There are a number of mechanisms that can lead to the development of resistance to antibiotics. It is very complicated science. However at a simple mechanistic level it is quite simple.

If you give an antibiotic (antibiotic A) and it only causes the death of 95% of the bacteria present, while it may treat the infection this time, what you are left with is a pool of 5% of the bacteria with a degree of resistance to that antibiotic. If subsequently that person passes on the resistant bacteria to another person or develops a second infection themselves then the bacteria will all be descended from the resistant ones and hence antibiotic A will have a reduced effect on that bacteria. And so it continues with increasing resistance each generation.

This is further complicated by the fact that bacteria which have a resistance to an antibiotic have the ability to package up the genetic code which confers the resistance and pass it onto neighbouring bacteria to spread it around.

The development of resistance is made worse by antibiotics being used for infections they are not suitable for i.e. they kill only a small number and encourage the resistance in the remainder requiring multiple courses of antibiotics to treat the infection. When the main cause of the infection is viral, antibiotics don't fix the problem – but what they do is cause resistance patterns to occur in bacteria present in the body, which are not currently causing disease so when they do cause an infection it is harder to treat. These commensal bacteria (ones we co-exist with and don't cause disease) can also develop antibiotic resistance – which isn't an issue as they don't cause disease – but then can pass on this resistance to other bacteria when the person develops an infection caused by more serious disease bacteria making them resistant and hard to treat.

Using antibiotics inappropriately is the main cause of antibiotic resistance and we have been the authors of our own misfortune here.

Why should we be concerned about antibiotic resistance in a grid down scenario? It is a very scary thing to look your patient in the eyes and tell them you no longer have a drug that will cure them because the bacteria are all resistant to the antibiotics we have. Even in the event of an economic collapse there is a likelihood that life will settle down to a new "normal", though it might be years away. In this new world, bacteria will most certainly be present to cause strife for man and we would like to continue to have tools available to treat man's bacterial illness. In addition to this, if used improperly you could see resistance develop to your antibiotic amongst your small group in a short period of time. For your sake, and the world's, please use antibiotics with care and judiciously.

b. Spectrum of Activity and Sensitivity

This is a important concept to understand. While there are different types of antibiotics (discussed next), we broadly classify them as broad, intermediate, and narrow spectrum. Basically put this refers to how many different types of bacteria a specific antibiotic kills – the wider the spectrum the more species the antibiotic is effective against.

The goal is to use the narrowest spectrum for the presumed infectious cause of any disease. The wider the spectrum the more you are contributing to resistance developing and exposing the patient to side-effects (which are generally more common with broad-spectrum agents). Sometimes there is no choice but to use a broad-spectrum agent. If you have no real idea as to the cause of an infection then hitting it with your biggest gun is the appropriate response. However, if you can make a reasonable guess as to what the likely bug is, using a intermediate or narrow spectrum agent which covers that bacteria specifically is a better option.

An antibiotic sensitivity refers to what bacteria are killed or have their growth specifically inhibited by that antibiotic. Knowing this enables you to choose an appropriate antibiotic rather just guessing based on spectrum of activity. It requires the bacteria to be grown (from a sample of urine or blood or pus) in the lab and then exposed to the antibiotic to determine this – for this reason, in a field situation, it is generally not possible. Having said that, it is very simple microbiology so even a simple lab may be able to do this.

c. Use in Pregnancy

In pregnancy, penicillins and cephalosporins are safe to use. Many others like quinolones and TMP-SMX are not (or only during certain parts of the pregnancy). You should always check if any drug you are using is safe before using in pregnancy and breast-feeding. Most drug and prescribing references will tell you if a specific antibiotic is contraindicated in pregnancy. If you want a specific reference try "Drugs in Pregnancy", Ed D.F. Hawkins.

When you have limited options in regards to safety in pregnancy you need to decide if the small (but real) risk to the baby is exceeded by the benefit to the mother i.e. if the mother would die without the antibiotic, then the risk to the baby would potentially be tolerable.

d. Use of Veterinary Antibiotics

There has been a huge increase in the storage and use of veterinary antibiotics (especially Fish and Bird antibiotics) in the last 10 years within the survivalist/prepper community.

Veterinary meds are widely available and are relatively cheap – you can by human grade antibiotics from many fish supply stores.

Most veterinary drugs come from the same batches and factories as the human version, the only difference being in the labelling. This is the case for most common single-component drugs such as antibiotics.

If you are going to purchase veterinary medications I strongly suggest only purchasing antibiotics or topical preparations and with the following cautions: (1) Make sure you know exactly what drug you are buying, (2) avoid preparations which contain combinations of drugs and obscure drugs for which you can find no identical human preparation and (3) avoid drug preparations for specific animal conditions for which there is no human equivalent.

Buy drugs which are generically identical to their human counterparts, e.g. Amoxicillin 500mg (Vet) = Fish Mox = Amoxicillin 500mg (Human). There are a number of other commonly used fish and bird antibiotics which are identical to there human counterparts including Penicillin (Fish-Pen), Cephalexin (Fish-Flex), Ciprofloxacin (Fish-Flox), Metrondiazole (Fish-Zole) and Trimethoprim-Sulfamethoxizole (Bird-Sulfa).

If you are purchasing and using these antibiotics you have an obligation to use them appropriately and avoid worsening bacterial resistance.

You also use these at your own risk.

e. Antibiotic Allergy

Allergies to antibiotic are common and, in particular, penicillin allergy.

The most important thing is to understand what exactly happened. Nausea, vomiting, diarrhoea and thrush are common side effects of many antibiotics and should not be classified as an allergy. A red rash in isolation of other serious symptoms is probably a mild allergy and care is needed with repeat dosing in case it evolves into something more serious – however most rashes are simple and don't go anywhere. A description of a life threatening allergic reaction should predispose you to extreme caution. This would include swelling of the lips/face, difficulty breathing, weak pulse, hives and wheezing.

What do I do if someone is allergic to penicillin (or another antibiotic)?

If allergic to penicillin, a macrolide such as Erythromycin can generally be used interchangeably where a penicillin-based antibiotic is indicated. Another alternative in many cases is a Quinolone, such as ciprofloxacin.

You need to clarify if you have a serious allergy to penicillin. A mild rash with penicillin is very common. It is only a small minority (a few percent) of patients who develop a rash who if re-exposed will develop a life-threatening allergic reaction. If you are in an disaster situation (with no medical help) with a life saving indication for a penicillin-based antibiotic, and a history of only a mild rash, and no alternative available, it is reasonable to give a single dose of antibiotic and be prepared for an allergic reaction.

If you have had a serious allergic reaction before (breathing problems, swollen lips or tongue, low blood pressure, or a wide spread lumpy red rash) then you should avoid the offending antibiotic under all circumstances and plan your medical supplies accordingly.

It is possible to look for evidence of a skin reaction to an antibiotic prior to administering if there are concerns about allergy. The contents of a capsule or a tablet should be crushed into a powder. You should use a sharpe needle to superficially scratch the skin – enough to cause a small degree of bleeding. The crushed tablet should be rubbed into the wound – the rapid appearance of a large welt or an area of welts around the scratch strongly suggest a allergic reaction is possible if the tablet in ingested.

The Antibiotic Families

Penicillins - These act by preventing bacteria from making or repairing their cell wall – the consequence is that they cannot control fluid movements and swell and die. A number of bacteria produce an enzyme which inactivates the penicillins (B-lactamase).

There are a number of varieties:

- Benzylpenicillin (Penicillin G Benzathine): Injectable preparation. Antibiotic of choice against severe Strep pneumoniae and Neisseria sp infections such as chest infections, meningitis, and cellulitis.

- Phenoxymethyl penicillin (Penicillin V): Oral preparation of above. Usually used only for the treatment of sore throats (strep throats – caused by Strep Pyogenes or Group A strep); in other infections largely replaced by amoxicillin, which is better absorbed. Penicillin has good penetration into the central nervous system and remains a good choice for infections there – particularly for infections caused by Neisseria menintidis. It can also be useful for chest infections (due to Strep pneumoniae) – although it isn't the first choice due to the fact there are many other bugs that can cause chest infections. It also has a role for potential dental infections as it provides reasonable coverage to several common bacteria associated with dental abscesses – however it is not a first choice.

The above were the first antibiotics and now there is wide spread resistance – particularly in Asia, Africa and North American – predominately as a consequence of inappropriate use and subsequent development of bacterial resistance. Both are narrow spectrum antibiotics only effective against a small number of bacteria.

- Flucloxacillin: Oral and IV drug of choice for Staph infection such as cellulitis, boils, abscess, and bone infections, (although in North America Cephalexin is more commonly used). Also usually effective against Strep but not first choice.

- Amoxicillin: (newer version of ampicillin): Is available as a tablet or for intravenous injection. It is well absorbed orally. It is effective against most gram-positive and negative bugs, but it has limited use secondary to B-lactamase resistance in many bacteria. Hence it is classified as intermediate spectrum. Beta-lactamase production is a method by which the bacteria try and protect themselves against an antibiotic – it is a bacterial enzyme, which breaks down the main active ingredient of penicillin antibiotics. This is overcome with the addition of clavulanic acid (one of the trade names is Augmentin). Overcoming this resistance makes this combination an ideal survival antibiotic, with good gram-positive, negative, and anaerobic cover and turns amoxicillin into a broad spectrum antibiotic. This drug is the best broad-spectrum antibiotic commonly available. Other antibiotics may be better for specific infections but this is the best all-purpose one. It covers the same bacteria as Penicillin, in addition it also covers a number of gram negatives such Haemophilus influenzae, Neisseria meningitidis, and members of the Enterobacteria family (like Shigella, Salmonella, and E. coli). It is also effective against Borellia the causative bacteria in Lyme disease.

  It is a good first line choice for strep throat, sinus infections, ear infections, urinary tract infections, and chest infections

Cephalosporins–These have a very similar method of action as penicillin antibiotics. Developed in four generations. The third and 4th generations e.g., efotaxime (Claforan, IV only) and ceftriaxone (Rocephin, IV/IM only) have the most broad spectrum effect.

They are effective against most gram-positives, negatives, and some variable anaerobic cover. The second generation e.g., cefuroxime (Zinacef, oral and IV) and Cefaclor (Ceclor, oral only) also have good general coverage, but are not as effective against some gram-negative bacilli. This loss of gram-negative coverage expands to most gram-negative cocci and bacilli in the first-generation cephalosporins e.g., cephalexin (Keflex, oral only) and cephazolin (Kefzol, IV only).

The third generation is ideal for use in those with very severe generalised infection, meningitis, or intra-abdominal sepsis (e.g., penetrating abdominal wound or appendicitis), with metronidazole added in to kill anaerobic bacteria, and the second-generation offers a good broad-spectrum antibiotic for general use in skin infections (cellulitis), wound, urinary, and chest infections. First generation (Cephalexin) is good for throat infections and skin infection as it gives good coverage against Strep pyogenes and Staph aureus.

Quinolones - Act by inhibiting DNA replication in the nucleus of the replicating bacteria. This is a relatively new generation of antibiotics and is broad spectrum. Most common is ciprofloxacin. They offer very broad-spectrum (including pseudomonas) cover except for anaerobes. That makes it an excellent survival antibiotic and our second choice due to the fact that amoxycillin + clavulanic acid gives better cover of anaerobes.

It is effective for most types of infections except intra-abdominal sepsis and gangrene. It overs good coverage for urinary tract infections, prostatitis, bone or joint infections and sexually transmitted infections. It also works for plague and anthrax. It has good penetration of the CNS so is a good choice for presumed meningitis.

While it will work for chest infection and strep throat it should generally be reserved for more serious infections, and its use to treat relatively simple infections has been contributing to quinolone resistance.

Quinolones are generally not suitable for children and can occasionally cause an idiosyncratic tendonitis predisposing a tendon rupture but this is fortunately rare (<0.1%).

Macrolides - Act by inhibiting protein synthesis in the replicating bacteria. Includes erythromycin, and the newer Roxithromycin, and clarithromycin. Often used for people with a penicillin allergy, however it does have a reduced spectrum (esp. with gram-negatives) but is an alternative to tetracycline in Chlamydia. First choice in atypical pneumonias, e.g. with Mycoplasma pneumonia.

Trimethoprim and Sulfmethoxizole (TMP-SMX) - Acts by interfering with folate metabolism in the replicating bacteria. TMP-SMX is a broad-spectrum antibiotic with a relatively good resistance pattern worldwide – although there are pockets of significant resistance. It is useful for urinary, skin and chest infections. It is one of the few antibiotics with good sensitivity against MRSA.

The main limitation to its use is a rare, but a serious side-effect is causing Steven-Johnson-Syndrome. It is not safe in pregnancy.

Tetracyclines (Doxycycline) – Acts by blocking protein synthesis – specifically by binding to and deactivating ribosomes in the bacteria. Broad-spectrum coverage – gram-positive, gram-negative, anaerobes; rickettsiae (syphilis, typhus), Chlamydia, and Mycoplasma. A commonly used treatment for common biological warfare agents – Anthrax, Tularaemia, Plague, Brucellosis, Melioidosis, Psittacosis, Q fever, Typhus.

It has good oral absorption. Can be given parentally – but commercial preparations now uncommon. Can cause bone and teeth growth problems when given to children. They used to be manufactured with a compound, which became toxic as it broke down – this no longer occurs.
Resistance is common in North America, Africa and Asia, but relatively uncommon in Australasia and Europe.

Metronidazole (Flagyl) - Acts by directly damaging the structure of the DNA of the bacteria/protozoa. It is the drug of choice for anaerobic infection (dental abscesses, pelvic inflammatory disease, bacterial vaginosis, aspiration pneumonia and intra-abdominal infections). It should be used with another broad-

spectrum antibiotic for anyone with possible fecal contamination of a wound or intra-abdominal sepsis (such as severe appendicitis). Also the drug of choice for parasitic infections such as Giardia. It can also be used to treat Trichomonas vaginalis (a protozoa that is transmitted through sex which can cause a frothy greenish fishy smelling vaginal discharge in women) – men can catch it but it is relatively asymptomatic in men.

From a side-effect perspective it can cause abdominal pain and has what is known as the "antabuse" reaction when given with alcohol – this means the person will feel almost immediately 'hung-over' and often quite violently.

In the same family as Metronidazole is Tinidazole (Fasigyn). The treatment course is usually shorter with generally less side effects and is cheaper. It is also more effective against Giardia.

Clindamycin

Clindamycin works by binding to the ribosome of the bacteria and interferes with the bacteria's ability to produce protein. It is a broad spectrum antibiotic and is effective against a wide spectrum of gram positive and gram negative bacteria. Importantly it is usually effective against most MRSA staph. It can predispose to developing infectious diarrhoea caused by Clostridium difficile which results from bacterial overgrowth in the gut due to "good" bacteria being killed by Clindamycin.

What is the most useful survival antibiotic?

In prepping, I think of this as a threat assessment as far as what is going to cause the most common mortality and morbidity in my environment and my population base, what's the treatment, stock that, what's the second most common etc…

In some cases it may not be practical (for logistic or financial reasons) to have stored a wide selection of antibiotics.

The following is our preferred list of antibiotics.

If you are limited in what you can get, we suggest you purchase and expand in this order. All are good broad-spectrum antibiotics and have different strengths and weakness.

1st. A Broad spectrum Penicillin (e.g. Amoxycillin + Clavulanic Acid = Augmentin©)

2nd. A Quinolone (e.g. Ciprofloxacin)

3rd. A Cephalosporin (e.g. Cefaclor)

4th. Cotrimoxazole/Septrim/Bactrim/TMP-SMX

5th. Metronidazole

6th. Chloramphenicol eye ointment

7th. Albendazole (not technically an antibiotic – an anti-worm treatment)

8th. Clindamycin

9th. A narrow spectrum penicillin (e.g. Amoxicillin or Penicillin)

10th. A staph specific penicillin (e.g. Flucloxacillin or Dicloxacillin)

Costs?

New generation antibiotics are expensive. Is it better to have 10 of the expensive ones or 1000 of the cheaper ones?

Without a doubt you are better off having more of cheaper older antibiotic than only have a few of a newer expensive one. A good example would be cotrimoxazole vs. moxifloxacin – both have similar (although not identical) spectrums and similar patterns of resistance among bacteria – but for the cost of single treatment course of moxifloxacin you could have (depending on the country you are in) anywhere from 10-25 treatment courses of cotrimoxazole for the same price – to us at least the choice is clear. For the average person working or preparing for an austere environment, old and cheap trumps new and extensive every time unless there is a strong reason not to.

How do I know I've chosen the right antibiotic?

In the post-apocalyptic scenario, you will have no such luxury. You will be having to play the odds. For instance, the bacteria most commonly isolated from acute ear infections are Strep pneumoniae (~55%), Haemophilus influenza (~25%), and Moraxella catarrhaliis (~15%). So you would pick Amoxicillin, since it generally kills all three. However, if it is one of the 2-3% of ear infections caused by Staph aureus, you would experience a treatment failure, as Amox does not kill staph. Playing the odds will be the only choice you have without the ability to culture bacteria and test their sensitivities as discussed above.

When should I stop using antibiotics?

It is impossible to offer advice, which will cover all circumstances. A reasonable general rule would be 48 hours after resolution of most major symptoms.

In the case of a patient who appears not to be responding to treatment, there are a number of possibilities - it is the wrong antibiotic for the infection, it is not reaching the site of infection, concentrations are not high enough (oral vs. IV), or the sepsis is simply overwhelming. You need to decide which is the most likely and proceed accordingly as you approach will vary depending on the presumed reason for the treatment failure.

Long-Term Antibiotic Storage

Antibiotic storage, like all medication storage, has some common enemies – light, heat and humidity. Medications stored in a cool, dry and dark place will last considerable longer.

SLEP. SLEP stands for "Shelf Life Extension Programme". The programme has been run by the US military since the 80's. The full results of the program are not publically available due to a combination of its security classification and pressure from drug companies. There have been several presentations at conferences and a couple of papers published in the medical literature. Based on this information it appears that the majority of antibiotic's are safe for a considerable number of years following their expiry date and are unlikely to cause any harm. Cool/dry/dark – will all lengthen shelf life.

Chapter 9: Sedation and Anesthesia in a Primitive Environment.

A. Risk

As we have said repeatedly in this book – this information is for a prolonged 'grid-down' emergency and its use within the current health care context is reckless in the extreme.

In the same way that surgery is a balance of risk and benefit – the risk of a surgeon with only book knowledge and limited practical experience vs. the risk of the disease process without surgical intervention likely to cause death - so too is it a risk vs. benefit analysis for an anaesthetic.

Is the risk of an anaesthetic given by an informed amateur less than the risk of no anaesthetic at all? It is thought that of the 70-80% that died post-amputation in the US Civil War – half of them died due to the physiological insult of having major surgery with no anaesthetic.

B. Basic Principles

There are some excellent concepts promulgated by the International Committee of the Red Cross, and while what we are talking here is fringe practice, some of those principles still apply.

1. Much of the world's surgery is done successfully without physician anaesthetists, or nurse anaesthetists and without anaesthetic machines.
2. All anaesthesia carries a degree of risk and that risk needs to be traded off against the benefits of giving the anaesthetic and the surgery it enables.
3. You need a dedicated "anaesthetist" – you cannot effectively be both Surgeon and Anaesthetist.
4. Routine pre-operative medication is not necessary.
5. Do not rely on bottled oxygen, get use to oxygen from a concentrator or no oxygen.
6. Safe monitoring is possible with regular pulse checks, blood pressure and pulse-oximetry.
7. Use local anaesthesia whenever possible
8. If you cannot get away with local anaesthetic turn to ketamine and dissociative anaesthesia

C. Sedation/Anaesthesia Options

Non-drug techniques:

1. Distraction and psychotherapy

Never under estimate the power of the mind.

Meditation has consistently been shown to substantially reduce pain scores in patients undergoing simple surgical procedures.

Play therapy and distraction are well established techniques for keeping children calm and co-operative during painful procedures in hospital – if the brain is actively engaged doing something specific and focused, it is less distractible by the pain from a surgical intervention.

There are dozens of different techniques described for this type of distraction therapy and we have not addressed individual techniques but information is readily available.

There are obviously limits to this approach, but masters of these dissociation and distraction techniques have successfully undergone major surgical procedures with a little local anaesthetic and their mediation techniques.

2. Cold

Cold has been used as a basis of local anaesthesia for centuries – it is variation on distraction – by stimulating the cold receptors in the skin, you distract from the stimulation of pain receptors that occur. For simple very short lived painful experiences (incising an abscess with a single stab or putting in a single suture) the use of ice or very cold water immediately prior to the act is useful in minimising pain – however from the moment the cold stimuli is removed you only have 5-10 seconds to accomplish your task. Ethyl chloride spray has been used for years to numb the skin prior to short/sharp procedures like inserting an IV.
It certainly doesn't give a deep anaesthetic into the deeper layers of the skin so it is only suitable for very short interventions.

Regional hypothermia (of arms or legs) has been shown to provide a suitable operating environment for amputations and wound debridement. A limb isolated with a tourniquet and then packed in ice and left for an hour has been shown to be usually numb enough to under a major quick surgical procedure. The problem with this technique is its variably effectiveness, the fact when the tourniquet is removed a significant degree of cellular waste and cold blood will rush into the main circulation and potentially have a depressant effect on the patient's heart. But it is relatively safe, in comparison to no anaesthetic.

Drug Options:

1. Local anaesthesia

It is perfectly possible to do many procedures pain free (or with minimal discomfort) under local anaesthesia – including the ones discussed in the Surgery chapter. Local anaesthetic field blocks and regional limb blocks are relatively simple to learn and perform.

A local anaesthetic can be as simple as injecting 4-5 mls of the local into the edges of a wound which needs to be repaired, through to a more complicated regional anaesthetic block which makes a whole limb or part of limb completely numb.

The book “Military Advanced Regional Anaesthesia and Analgesia” (easily found online with a Google search) provides good technical descriptions for how to perform regional anaesthetic blocks. The majority are described with the help of ultrasound. But in an austere environment these blocks are safe and appropriate without USS.

The main limiting factors are:

a. Toxicity: We have already discussed that there is a mg/kg limit for the administration of local. The procedures are bigger and the potentially for repeat anaesthesia because of longer procedures, the more risk of toxicity.

The first sign of toxicity is usually tingling around the mouth/face, followed by a seizure if administration continues and rarely a serious abnormal heart rhythm. If patient ever complains of tingling around their lips stop administration immediately.

	Max dose/kg	Max dose/kg with epinephrine
Lignocaine	4.5 mg	7 mg
Bupivicaine	2.5 mg	3 mg
Prilocaine	5 mg	7.5 mg

b. Inadequate muscle relaxation to enter the abdominal cavity: This can be overcome, but makes complicated surgery more complicated and that’s bad for the occasional operator.

Lignocaine/Lidocaine. This is probably the most ubiquitous local anaesthetic. It is widely available throughout the western world – several "adventure first aid kits" are sold with it as a local anaesthetic and in many first world countries it is available as a pharmacy only medicine – you should investigate your local jurisdiction.

It is also available in a powder form which may be more suitable for long term storage than the more common commercial preparations of lignocaine solution.

Benadryl as a local anaesthetic

Generally, Benadryl (Diphenhydramine) is supplied in 1 ml. ampules containing 50 mg/ml. It can be diluted for use as a local anesthetic – 1ml can be dilute down to 5ml with the addition of a diluent like normal saline or 5% dextrose giving a concentration of 10mg/ml. This solution can be used as any standard local anesthetic – it takes about 10mins to work and will last 30-60mins. Its main side-effect is that it can cause marked drowsiness. It also is painful to inject.

Benadryl tablets can be crushed and made into a paste. The paste can be packed into the wound and will provide a degree of local anesthesia to the wound edges.

Low-tech manufacture of local anaesthetics.

Cocaine is the archetypical local anaesthetic and easy to manufacture directly from the plant. However access to and possession of the coca plant is highly illegal in pretty much all-western countries with massive penalties for possession. However, should it be available a sterilised tincture of coca leaves is suitable for local anaesthesia by infiltration or direct application to mucosa surfaces

The manufacture of all other synthetic local anaesthetics' is not technically possible in a low technology environment from simple chemical ingredients.

Spinal Anaesthesia

This is the injection of local anaesthetic into the epidural space (around the spinal cord), it allows major surgery from belly button down. It is a high-risk technique without appropriate training, although it is simple to learn and is taught to untrained health assistants in the Third World. The main risk is hypotension (the so called "high block"). The patient is sat up and small amount of local is injected into the spinal canal.

Doses

Lignocaine 1%	2mls
Bupivicaine 0.5%	2-4mls

Hyperbaric preparations have sugar added to make it "heavier" and sink more and not 'float' in the spinal fluid to the respiratory muscles.

Spinal anaesthesia is frequently performed in the Third World without a dedicate anaesthetist by the person also performing the procedure.

Local Anaesthetic Blocks

The following is a brief description of using lidocaine or bupivicaine as a local anesthetic. When using these agents, you will notice several tissue changes that indicate your block has been effective. Used alone, lidocaine causes the vessels to dilate which leads to warmth of the skin and increased bleeding. The addition of epinephrine causes vessel constriction to counteract these effects. When anesthetizing with a lidocaine/epinephrine solution, the skin will become blanched (white), cool to the touch and will stop bleeding (or decrease bleeding significantly).

Lidoocaine has a very short onset of action and begins working almost immediately. It will last for about 30-120 minutes. Use with epinephrine, the lidocaine block can be expected to last for 60-240 minutes. Bupivicaine takes longer to start working but may provide anesthesia for up to 8 hours.

Direct infiltration

For wound closure, it is beneficial to inject the drug into the wound margins through the wound itself. Because intact skin is not pierced, needlestick pain is less. This method should only be used for minimally contaminated wounds, though, as the needle can drag bacteria into the periphery.
Using a 25ga needle or smaller, insert the needle through the open wound into the fatty layer just deep to the dermis of the skin. Inject a small bolus of lidocaine. Remove the needle and repeat the procedure a short distance away, but inside the margin of anesthesia from the previous injection. Continue this until all edges of the wound are anesthetized.
Explain to the patient the advantage of less pain with this technique and it will make them more comfortable with the idea.

Field Block/Line Block/Parallel Margin Infiltration

This method can be used when the wound is grossly contaminated and requires less needlesticks. The objective is to infiltrate a small amount of anesthetic solution into a line that parallels the wound margin or proposed incision line.
Insert the needle into the intact skin about ½" away from the wound margin, at the end of the wound. Advance the needle to the hub in the space just below the dermis, in the superficial facia layer that is above the fatty layer. The needle should run parallel to the dermis. Injection into the dermis is painful and is met with great resistance (it's hard to push the plunger). Aspirate (pull back on the plunger) to make sure you're not injecting into a vessel. (If you see blood, remove the needle and start over.) Slowly inject the anesthetic as you withdraw the needle, to leave a track of anesthetized skin where the needle was. Reinsert the needle at the tip of the previously anesthetized spot and repeat the procedure. Using this technique will provide less pain. Continue until the desired area has been blocked.

Topical Anesthesia

Some patients, children in particular, are averse to needles. In this instance it is useful to use topical anesthesia to block the wound. Saturate a 2x2 gauze sponge with the anesthetic solution and place it in and around the laceration. Leave it in place for at least 20 minutes. Shortening the time will lead to failure of anesthesia and patient discomfort. Once the gauze is in place, it may be taped to secure it. The caregiver can apply gentle pressure over the taped sponge. A zone of blanching will be seen when complete anesthesia is reached.
Once topical anesthesia is complete, you can clean and debride the wound or use the anesthesia to further inject local anesthesia around the wound as described above.

2. Botanical Local Anaesthetics

i. Wolfs' Bane/Monkshood (Aconitum sp.)

Plants in the Acontum family have been used for hundreds of years as a analgesic and anesthetic. It is thought to work in a similar way to other local anesthetics blocking the generation of impulses in nerves. The problem is that in overdose it is deadly – causing fits and

cardiac arrhythmias. The line between being a useful local anesthetic and a deadly poison is very fine. Wolfs' bane should never be injected or swallowed. It can, in small amounts, be smeared along cut edges of a wound to produce anesthesia but the patient should be watched very closely for signs of toxicity.

ii. Capsicum

Capiscum is a component of chili peppers, in particular cayennes, that provide an analgesic effect on skin. A tincture of chilis can be used as an additive to topical creams and ointments (or the tincture directly as a "rub"). The effect of the capsicum, in a relatively gentle manner, is to stimulate the pain receptors in the skin – causing a slight burning sensation. This acts a distraction to other pain receptors that are being activated. Examples include things like lower back pain or a painful knees or ankles – the capsicum ointment or tincture can be used to rub over the painful area causing a degree of distraction.

3. Sedation and General Anaesthesia

This gets very risky, very quickly. Sedation and anaesthesia in untrained hands is a huge risk and that risk is only just tolerable when the alternative is certain death. An untrained and inexperienced person giving anaesthesia is a recipe for death and disaster. These warnings are prominent throughout this book, but they apply especially to this situation – this is for a true end of the world situation and we really cannot stress this enough.

At the very least the following skills or equipment are required before embarking on austere general anaesthesia.

- A dedicated “anaesthetist” – not involved in the surgery in anyway.

  With the ability to:

  - Manually maintain an airway (and use simple adjuncts to help e.g. oral or nasal airways) – this is discussed in detail in the Resuscitation chapter and is not as easy as it sounds and requires practice.
  - Monitor vital signs and understands the concept of depth of anaesthesia
  - Assess and assist respirations if required.

- Oral and nasal airways and a bag-valve-mask self-inflating bag (if at all possible).

- A stethoscope and blood pressure cuff.

- Pulse oximetry is strongly desirable – the level of availability of equipment may be variable depending on the scenario but given the importance and current availability of these devices if possible several should be stockpiled as part of your medical supplies.

If potentially delivering an anaesthetic is part of your preparations, you should develop a specific airway kit containing all of the above items plus:

i) Laryngeal mask airways in several sizes
ii) Endotracheal tubes in several sizes – appropriate sizes for the patient

When the agent is administered the patient's airway, adequacy of breathing and pulse must be constantly monitored and recorded – at least every 5 minutes. classically Heart rate / Blood pressure/Respiratory rate/and Oximetry if you have it (and many other variable besides in the First World) are recorded in a graphical format – try and do this where ever possible, it often will make the subtle changes stand out more.

The patient should be fasting for at least 6 hours for solid food and fluids. Although small sips of fluids water are ok up to 2 hours before hand. If the patient is not starved they are at significant risk of aspiration of stomach contents.

Again with modern anaesthesia there are ways around patients with full stomachs in terms of drugs and approach to the anaesthetic, most of these mitigating things will not be available so fasting times are very important.

There are only three real options for low-tech general anaesthetic if that is what is required.

1. Ether anaesthesia
2. Intravenous pure ethanol
3. Dissociative Ketamine anaesthesia

1. Ether Anaesthesia:

Ether was one of the first general anaesthetic agents developed in the early 19th century. It was used extensively from then thru until the 1950's and 60's. Ether is now hardly used anymore, even in the Third World and ketamine and regional anaesthesia has pretty much taken over, but it is still out there, ether administration equipment is readily available and finally the main reason it is worth discussing is that it is relatively easy to produce (see Primitive Medicine chapter)

Open drop. The classic route of administering ether is using the "open-drop" technique. It is administered by dripping the ether onto a gauze square or piece of absorbent material held over face by a wire frame to prevent direct contact of the ether with the skin and to facilitate airflow. Ether is a solvent and contact with the skin or eyes can cause serious burns. The patient's face and eyes should be covered with gauze to protect them – if available Vaseline should be applied to exposed skin.

One common ether mask was the Schimmelbusch mask (below); this provides an example of what we are aiming for in making an improvised mask, which can easily be manufactured with some number 8 fencing wire or a coat hanger.

Schimmelbusch ether mask.

An improvised mask can be made with a small kitchen strainer (an ideal size will just fit over the mouth and nose) or you can manufacture a similar frame using medium gauge wire.

The ether is poured onto the gauze (you would need multiple layers) – the gauze should be saturated with ether. The gauze may need to be changed frequently as when the ether evaporates off as it causes "frost" to form on the gauze interfering with its effectiveness.

Gauging the depth of anaesthesia with ether is an art in itself – when is the patient deep enough to begin the operation, how much to give them to keep them asleep, how not to give too much and kill the patient. This is A VERY INDIVIDUAL THING. But rough guidance over drip rates are given below (to give an idea of the pattern of increasing volume during the anaesthetic) slowly increasing depth of anaesthesia to reach a level where surgery can be performed and then reducing slightly as the body becomes more saturated with it.

Ether (Drops/min)	Ether (mls/min)	Time (min)
12	0.6	1
24	1.2	2
48	2.4	3
96	4.8	4-15
50	2.5	15-30
20-30	1-1.5	after 30

Accurate time keeping is very important and constant monitoring of vital signs. You should really have two anesthetists with this drug—one to administer the ether and one to monitor vitals and keep time.

It is difficult to induce anaesthesia in an adult using the "open-drop" technique due to problems reaching high enough concentrations around the mask. This can be overcome by using an ether chimney. This is essentially a metal column which sits over the mask, holding the vapour at a higher concentration close to the face which increases the concentrations being breathed in. It is also worth getting the patient used to the smell of ether first as it is highly potent and can cause coughing fits.

Draw-over technique: The other way ether can be administered is via the "draw-over" technique. This technique is the basis of modern anaesthetic machines. The inlet value for the circuit the patient is breathing though is on the far side of a reservoir of the anaesthetic being used (in the case ether). As the patient breathes the air or oxygen is "drawn-over" the ether – as ether is very volatile (i.e. it turns into a gas) at room temperature – the ether gas mixes with the air – and the patient breaths in the mix and keeps themselves asleep. There have several commercial ether draw-over circuits on the market over the years – but at its most simple level it is simple a sealed tin – with the patient breathing air pulled through it.

Ether is highly flammable. It should only be used in a very well-ventilated area and there should be no open flames or sources of sparks in the environment.

A secondary reason for using a ventilated area is to ensure the person acting as the anaesthetist or surgeon are not affected by the fumes of the ether – at a practical level this is rare – but staff should have awareness of this as a potential problem.

Depth of ether anaesthesia: Ether presents a classic pattern of clinical signs as it takes effect – this is described as the depth of ether anaesthesia - the patient is only in a suitable state to be operated on at stage III.

We look at the patient's eyes (especially the pupils), breathing and respiratory muscles, muscle reflexes and heart rate and blood pressure.

Stage I – Analgesia

Stage II – Delirium

Stage III – Surgical
- Plane 1
- Plane 2
- Plane 3
- Plane 4

Stage IV – Respiratory paralysis

Stage I – Analgesia

This covers the period from when you begin the anaesthetic to when the patient loses the ability to respond to your voice – their conscious state begins to fall. Over this phase the patient begins to respond less to painful stimuli, but is still awake – so an analgesic affect.

Eye movements are normal and under voluntary control.

During this phase the patient may quickly (several minutes) become unconscious and then slowly awake again this is due to the ether rapidly accumulating in the brain and then slowly distributing around the rest of the body causing the concentration to fall again. This is referred to as the "false plane" or " brain anaesthesia". The only way to tell the difference between true anaesthesia and the "false plane" is the length of time which has passed. It takes at least 5-10 minutes to reach Stage III and this transient anaesthesia occurs after only 1-2 minutes. Beginning an operation during the false stage can cause massive physiological stress and due to the ether sensitising the heart precipitate a cardiac arrest. This is usually ventricular fibrillation – which is potentially treatable with a defibrillator if available.

Stage II – Delirium or excitement stage

This stage occurs at the point consciousness is properly lost (not 'the false stage'). During this stage the patient is unconscious and has lost the inhibition of the higher brain on the brain stem. This may result in agitation or violent physical movements. These are generally provoked by external stimulation, such as loud noise or sudden movements. During this stage, stimulation should be keep as low as possible.

There is also the same risk of cardiac arrest during this stage. It is thought it is due to high levels of adrenaline due to fear and stress and anything which can be done to minimise this should be tried e.g. pre-medication if possible (such as Phenergan or a benzodiazepine such as diazepam), avoidance of stimuli and gentle restraint if getting agitated.

There are random rapid bizarre eye movements.

Pupils are dilated initially but become constricted entering Stage III

Vomiting can occur at the lower edge of stage two and should be anticipated.

Stage III

a. Plane 1- at this stage:
    - The patient is unconscious
    - There breathing has become full, deep and regular. The tidal volume and respiratory rate is increased. It is usually 25-30% and should be readily apparent.
    - Inspiration is shorter than expiration – quick(in)/slow(out)/quick(in)/slow(out)
    - Gag/swallow reflexes and eyelid reflexes are still present but starting to be depressed.
    - The rapid bizarre eye movements continue but slow as depth increases.
    - Pupils are constricted at the start of plane 1 and become progressively more dilated a depth increases.
    - Settles from mild tachycardia and hypertension to normal BP and HR.
    - Abdominal muscles begin to relax.

b. Plane 2 – at this stage
    - The tidal volume has decreased; rate may go up or down.

- The pause between inhalation and exhalation shortens and both inspiration and expiration are similar lengths.
- Eye reflexes are lost.
- Gag and swallow reflexes are markedly reduced.
- Eye movements stop.
- Normal heart rate and blood pressure.
- Abdominal muscles become completely relaxed.

c. Plane 3 – at this stage
   - Paralysis of intercostal muscles begins.
     - Inspiration begins to look jerky.
     - The diaphragm begins to move down before the intercostal muscles cause the thoracic cavity to rise / expand.
   - Pause between inspiration and expiration becomes longer.
   - The tidal volume decreases as intercostal paralysis becomes more pronounced – the bony thorax is stationary and intercostal retraction / recession can be seen.
   - Gag and swallow reflexes lost.
   - Hypotension begins / heart rate increases.

d. Plane 4 – at this stage
   - Diaphragmatic movement becomes very pronounced and appears jerky.
   - This stage immediately proceeds respiratory arrest.
   - Flaccid paralysis.
   - Slight hypotension/heart rate rapid.

Stage IV

Defined by respiratory arrest.
Death will occur within 2-3 minutes without really active intervention.
Hypotension occurs and heart rate is weak and irregular.
Flaccid paralysis occurs.

The goal is to stay within Plane 1-2 if possible. Plane 3 may be required for abdominal surgery. Plane 4 is too deep and a red flag! The patient will imminently enter stage IV and potentially collapse.

Recovery

It can take a considerable period for a patient to wake up after an ether anaesthetic. As they wake up they pass through the same planes of anaesthesia as when they are induced, in the reverse order. So as they wake they may become agitated or aggressive as they pass through stage II. It is reasonable to stop administering it slightly before the operation is finished. Ether also causes excess production of secretions in respiratory system and this potentially can cause problems with breathing – where possible, Atropine should be administered to prevent this from occurring.

2. Pure Intravenous Ethanol

Historically prior to modern anaesthesia, the patient was often rendered insensate with a large amount of alcohol taken orally. For some people, it did render them unconscious enough for a surgical procedure but for the majority it really only rendered then unconscious until the first incision.

Early last to mid-century, there were many experiments with intravenous pure ethyl alcohol and it started to establish itself in anaesthetic practice. It was shown to be an effective anaesthetic agent. Its peak of use was in the 1930-40s and better agents superseded it. Its main problem was at a dose sufficient to cause operative anaesthesia, it had a potential to cause severe hypotension and respiratory depression. The results could be catastrophic. These can also potentially be managed – this is another example of the risk vs. benefit of this type of practice.

In terms of practical use:

- A 5-10% solution of pure ethanol is added to a 1000mls of 5% dextrose (or normal saline). Ethanol in high concentrations is very damaging to veins and if given straight will cause significant damage and destruction.

  This is then titrated to clinical effect. Usually 200-400mls as a starting dose, titrated to the loss of lash reflex (for surgery not requiring muscle relaxation) and loss of intercostal respiratory effort (for surgery requiring a degree of muscle relaxation). The problem is that the step between loss of intercostal respiratory effort and loss of diaphragmatic respiratory effort (i.e. the patient stops breathing and dies) is very narrow. In order to even consider safely using this medication you must have the knowledge and ability to maintain an airway and to manually breath for the patient for a potentially prolonged period of time while they metabolise the ethanol.

- Once the desired depth of anaesthesia is reached, the drip should be slowed and allowed to run slowly to maintain anaesthesia. The patient may require an increased bolus from time to time to achieve this.

- In addition to managing the airway and ventilation you need to have the ability to monitor and treat low blood pressure. For minor drops in BP, elevation of the lower limbs may be all that is required but the ability to give intravenous fluids is mandatory.

3. Ketamine

Ketamine is a general anaesthetic agent with unique properties. It has gained a reputation as street drug and as a vet anaesthetic, but is also widely used in human medicine, and is an ideal anaesthetic agent for austere situations. The problem is that, like many medications, access to the general public is limited and possession is illegal and a serious crime; although it has limited availability for medics working with expeditions.

This is the only "modern" anaesthetic drug we discuss in any detail because of its very high safety profile and that all the available evidence suggests provided the cautions above are followed is that it is very safe for non-anaesthetists.

It produces a state known as "dissociative anaesthesia" – meaning it produces conditions suitable for performing painful procedures and operations while the patient appears to be in a semi-awake state although unresponsive. A side effect of this anaesthetic state is relative preservation of airway reflexes, respiratory effort, and a stable cardiovascular profile.

It is contraindicated in patients with an allergy to it (rare), and should be used with care in patients with psychiatric history, and patients with severe head injuries. Its main side effect is "emergence agitation" as the patient is waking up from the anaesthetic they may hallucinate and become agitated – this can be minimised by waking the patient up in a quite dark environment, and can be treated with benzodiazepines such as Diazepam (Valium) or Midazolam (Versed) if a problem.
It also causes an increase in respiratory secretions and can cause transient increase in muscle tone.

Due to its ease of use and lack of airway or respiratory suppression it is the ideal drug for use in an austere environment. It has been used extensively in the third world and has an excellent safety profile in comparison to other anaesthetic agent. While it may be difficult to obtain, its perfect profile as a "expedition anaesthetic drug" makes it worthy of extensive discussion.

Administration:

It can be administered intramuscularly, intravenously and orally. It works well by any these routes, however orally its onset and offset are more unpredictable.

The patient should be monitored as described above.

IV dose: 1 mg/kg initially, then 0.5 mg/kg repeated as required to complete the surgical procedure. The indication to repeat the dose is when the patient starts to respond purposefully to the surgical stimulation.

IM dose: 4 mg/kg initially, then 2 mg/kg repeated as required to complete the procedure.

Oral dose: 4 mg/kg initially. The oral dose cannot be repeated, so it is only suitable for short procedures.

Ketamine as an analgesic

In addition to its general anaesthetic proprieties, ketamine at lower does it also has profound analgesic (pain relieving) properties. The generally principle is that you use an 1/8-1/4 of the anaesthetic dose for analgesia only.

It is particularly useful for burns, extrication (when the patient is injured and stuck and need to be moved) and for large bone fractures.

Summary

The idea situation would be to get a big supply of local anaesthetic and if possible, some ketamine. Due to the supply issues, that is unlikely for most. An alternative would be a supply of several litres of diethyl either in your stores, and local anaesthetic if you can find it.

Know how to keep an airway open and when to provide assisted ventilations (and have the equipment to do it). Know how to do basic physiological monitoring and know how to recognise abnormalities if they occur.

A DIY anaesthetic is always going to be a very risky proposition, but like surgery, it is not impossible nor necessarily reckless in the right circumstances. But the risk of doing nothing needs to exceed the risk of a DIY anaesthetic. It is always a balance of risk vs. benefit. However, if you have read this chapter and it makes little sense to you, then that is really all you need to know - stay clear of anaesthetics!

References

Primary Anaesthesia by Maurice King.

Chapter 10: Major Surgical Procedures

In keeping with the basic themes of the book, there are conceivably times when access to medical care is not possible and the alternative is death. It is in these circumstances that undertaking "heroic" surgical intervention can be lifesaving. The first principle of medicine is "first do no harm" and that needs to be the over-riding principle here. Having said that there is a substantial group of patients who will die without intervention. The trick in austere medicine is to pick which patient this is likely to occur in and intervene at a point where it isn't too late – but at the same time not to early, just in case mother nature and non-surgical interventions take care of the problem.

At least one author has written that education leading to surgical procedures is reckless and unsafe, and the benefit never justifies the risk. That is patently not true – every aspect of medicine is a juggle of risk vs. benefit. Context is important, and having the knowledge to clearly know which situation you are in is vital, but the risk you take is circumstantially dependent:

> Death certain with no treatment = potential benefit to a high risk procedure.
> Death unlikely regardless or only a medium risk of death = no benefit to a high risk procedure.

In this chapter we consider six different surgical procedures. Several are described as stepwise procedures and several others are discussed as a broad narrative. Everyone is different and generally speaking the slimmer/skinnier the patient is, the easier the procedure is likely to be. You also need to know the anatomy – if you don't there is no point in considering this sort of procedure. Knowledge of the anatomy (assuming the above points have been considered) is the way these operations can be safely completed. If you have no anatomical knowledge then there is no point in even contemplating any of this.

Once again these descriptions are for situations where there is no access to medical care in the medium term – days/weeks rather than hours. There is a serious risk of causing death with these procedures and if you make a decision to proceed incorrectly it is likely that will occur. We are talking about a situation with no access to doctors or hospitals - a major power-grid down collapse or massive disaster. Not just a being a bit isolated in the bush or after a small natural disaster - this is only for where there is no medical system or it has completely collapsed.

By way of context it is worth remembering that there are at least 4 documented cases in the second World War of Navy medics (with little more than first aid certificates) safely supervising a general ether anesthetic and removing an infected appendix - importantly with the patient surviving - largely with instructions from a book and an anatomy atlas. While not ideal, and probably cosmetically sub-optimal – it can be lifesaving. Again historically there has been dozens of cases of caesarian sections going back to antiquity and while mother and baby didn't always survive them, they did survive often enough for it to be a real consideration in an austere environment – especially when approached with a modern knowledge of basic surgical care and anesthesia.

Historically all sorts of major surgeries have been done without any anaesthetic. It was brutal, hideously painful and the death was rate high, but frequently from infection rather than the stress of no anaesthetic – although deaths from stress did occur.

For liability reasons we have deliberately not described the exact surgical techniques, just broad descriptions of the steps, but clear descriptions for most procedures are easily found in surgical textbooks.

All require some basic surgical skills in terms of handling tissues, tying off blood vessels and suturing. But the basics of this knowledge is not complicated and much can be learned on animal models.

1. Basic Surgical Principles

There are five broad principles that apply to all operative procedures – major or minor:

Anti-sepsis
Gentle tissue handing
Haemorrhage control
Irrigation
Anaesthesia

1. Anti-sepsis: Your hands need to be as close to sterile as possible, your instruments need to be as close to sterile as possible and the patients skin needs to be as close to sterile as possible. This is discussed at more length in Chapter 16. Sterile is the gold standard, if you cannot make sterile then super clean and washed is a distant second. If you skimp on these things the risk of infection goes up enormously. Sterile gloves are best, followed by non-sterile gloves, followed by a 5-6 minute hand wash with an antiseptic soap. Drapes and gowns, if used, should be as clean as possible having been boiled or soaked in antiseptic solution. Plastic sheeting having been soaked in antiseptic or disinfectant solution will work if that is all that is available.

2. Gentle tissue handling: Human tissues, especially the tissues inside the body are delicate. They rip, tear, bruise and bleed very easily. If you approach this roughly you will damage and destroy tissue. Be gentle. Use instruments gently. Make small incisions. Only cut something if you know what it is and it is appropriate to do so. Fortunately the body is very forgiving and as long as layers are approximated and bleeding controlled, and provided infection doesn't occur, things will usually heal. But be gentle to the tissues!

3. Haemorrhage control: Haemorrhage control is simply important because at a macro level if you do it badly the patient will bleed to death. At the more micro level, small haematomas in surgical wounds

slow healing, cause post-op pain and can act as a focus for infection. Every vessel should be tied off as you proceed with your incisions and your operating "field" should be kept free of blood – either by mopping it up with gauze or through suctioning it from the wound. Haemostasis (the control of bleeding) is very important. It is learned skill – but the basic rule is control bleeding as you go.

4. Irrigation. When it comes to wounds "the solution to pollution is dilution" – this is even more important when it comes to surgical incisions and wounds – particularly if you have entered the abdominal cavity. You need 10+ liters of sterile (boiled and cooled) water or normal saline and a working suction device. At the completion of any procedure (before you close the wound) you need to irrigate the operation field with litres of sterile fluid.

5. Anaesthesia. This is one of the key advances of modern medicine. Regardless of if this is local or general anaesthesia, the safe completion of surgical procedures depends on this. While possible to tie someone down and just cut, the physiological stress created by the pain and physical intrusion can be fatal. Some form of sedation or anaesthesia is mandatory. This is discussed in more detail in Chapter 9.

2. Procedures

Basic wound care and debridement.

This is an extract from the US Special Forces Medical Handbook published in 1982 – it contains a chapter on War Surgery, which covers debridement of wounds well, and aspects of wounds to other organ systems – and unfortunately was not included in the new edition:

" 16.2 Soft Tissue Injuries

A. In the following surgical procedures we will assume that the medic knows how to prepare a patient for surgery and set up a surgical field

B. The primary objective in the treatment of soft tissue injuries is localisation or isolation of deleterious effects of the injury. To best accomplish this objective, remove all foreign substances and devitalised tissues and maintain an adequate blood supply to the injured part. This can be achieved by a 2 step procedure:

1. *Step one is a through debridement of the injured area, accomplished as soon as possible after the injury (when delay is unavoidable, systemic antibiotics should be started) The wound should be left open (with a few exceptions) to granulate.*
2. *Step two is a delayed primary closure within 4-10 days after injury. The wound must be kept clean during this time and antibiotics are usually indicated. The indication for delayed primary closure is the clean appearance of the wound during this time.*

C. Antibiotic wound therapy. This should be started prior to debridement.

- *Penicillin – 10 million units IV q8hrs for 3 days*

- *Kanamycin – 500mg IM q12hrs for 3 days – then review*
- T*etanus Toxoid 0.5 ml IM once*

<< Editors note. Current military recommendations for antibiotic therapy for wounds is Cefotetan 2gm given every 12 hours >>

D. Debridement

1. *An incision is made in the skin and fascia long enough to give good exposure. Good exposure is required to allow adequate evaluation. Incisions should be made over the wound (both entrance and exit wounds in GSW's) along the longitudinal axis of extremities (s-shaped if crossing joints). Avoid making and incision over superficial bones. When excising skin only, cut 2-3 cm from the wound edge.*

Skin, fascia, and muscle should be separated to give adequate exposure. Muscles should be separated into their groups and each muscle group debrided separately.

2. *Distinguishing tissue viability. Use the 4 C's – Colour, Consistency, Contractility and Circulation. With colour being the least desirable.*

3. *Steps of Debridement. All devitalised muscle must be removed; if not, the chance of infection is greater. It is better to take good muscle and have some deformity than to leave devitalised muscle and have infection. The preferred method for debridement is to cut along one side of a muscle group in strips or blocks and not piecemeal*

a. *Remove all blood clots, foreign material, and debris from the wound during exploration of the wound with a gloved finger.*
b. *Vital structures like major blood vessels and nerves must be protected from damage.*
c. *All procedures must be carried out gently with precision and skill.*
d. *Major blood vessels must be repaired promptly.*
e. *All foreign bodies must be removed, including small detached bone fragments, but time must not be wasted looking for elusive metallic fragments which would require more extensive dissection.*
f. *Tendons usually do not require extensive debridement. Trim loose frayed edges and ends. Repair should not be performed during initial treatment.*
g. *Haemostasis must be precise.*
h. *Repeated irrigation of the wound with physiological salt solution <or water if no alternative – although this isn't ideal> during the operation will keep the wound clean and free of foreign material.* ***THIS STEP CANNOT BE OVER EMPHASIZED!***
i. *When debridement is complete, all blood vessels, nerves, and tendons should be covered with soft tissue to protect from drying out.*
j. *Joint synovium should be closed or at least the joint capsule. The skin and SC tissues is left open in any case.*
k. *Dependent drainage of deep wounds must be employed << Place a Penrose drain (rubber tube) or wicking gauze into the wound>>.*
l. *Liberal fasciotomy of an extremity is often an additional precaution that allows for post-operative swelling. Use when the 5 P are present distal to a limb injury – pain, pallor, pulselessness, puffiness or paraesthesia*

m. *Do not dress the wound with an occlusive dressing, but place a few strips of fine-mesh gauze between the walls of the wound, placed puffed gauze in the pocket formed and then dress the wound to protect, but not constrict.*
n. *All wounds should be left open with the exception of wounds of the face, sucking chest wounds, head wounds, wounds of the joints or synovial membranes, and wounds of the peritoneum.*
o. *Immobilisation and correct positioning of the injured part promotes healing, and these measures should be used even of no fracture is present.*

Abscesses

An abscess is a collection of pus. It is the debris of infection – dead cells, dead bacteria and cellular debris. There is spectrum of sizes from a small 1 ml skin boil to a 2 L liver abscess. The treatment is drainage, not antibiotics.

Abscess vs. Cellulitis

Abscess = collection of pus
Cellulitis = infection of the skin

They can co-exist together. If only a small area over or immediately around abscess, then draining the abscess is the only treatment required. If there is extensive cellulitis or lymphangitis (spreading red limbs on a limb), consider antibiotics.

Treatment

The treatment is incision and drainage; and generally is a simple (but often painful) process.

1. Identify area of most flocculence. One technique is to apply a paste of calamine lotion or even clay, which is allowed to dry – the first spot to dry is the area of most flocculence and the place to make the first incision.

2. If you have it, the area around and over the abscess can be infiltrated with local anaesthetic. Be advised however that local anaesthesia does not take well to tissue that contains pus.

3. Aspirate first if you can to find the cavity.

4. Stab incision of two lines making an x-shape. Trim edges off – to prevent it closing over and allow the pus to drain out.

5. Irrigate the inside of the cavity and probe inside of the cavity to break down any internal septa.

6. Large abscesses may benefit from packing with gauze for several days to allow it to begin to heal, but not close over. The gauze should be coated with sterile white

petroleum jelly or antibiotic ointment to prevent adherence to the inside of the wound.

Antibiotics are indicated for significant cellulitis associated with the abscess or if there are persisting systemic (fever, chills, rigors) symptoms after drainage.

Special Abscesses

Breast abscess
Mostly occur in lactating mothers, occasionally due to trauma or malignancy. Due to the location of the milk ducts the treatment should be aspiration rather than incision and this may need to be repeated a couple of times. If it is not settling and does require an incision, use a radial incision to avoid damaging milk ducts.

Peri-anal abscesses
This is a relatively common. If superficial, they present with local pain and swelling. Deeper infections present with pain, pressure in rectum and fevers.

They vary from simple to complex. The simple comprise small, localized superficial abscesses and are treated with incision and drainage. The more complex are usually larger and deeper and more prone to complications. The primary complication is the development of a fistula that connects the abscess to the large bowel. It is potentially a big problem with no easy treatment. Drain the abscess, but it will likely keep recurring in the majority of patients.

Infected sebaceous cyst
These initially develop as a lump and grow for over months to years. They are due to a blocked sebaceous gland where oily material accumulates and it continues to grow. They are very common on the back. When they become infected it is usually obvious as it becomes red, hot, and sore. They should be treated initially with antibiotics such as Flucloxacillin or co-trimoxazole. When the infection has "settled down" or before they flare in the first place, the sac of the gland needs to be excided and shelled out.

Appendectomy

This truly is a potentially lifesaving operation usually with a clear diagnosis. It was a common cause of death up to end of 18th Century. A recent novel (James Kunstler's "The Witch of Hebron") contains a description of an appendectomy done in the circumstances we are describing and there also are a few descriptions of this done by military medics with no surgical training. It is not difficult surgery (on a surgical spectrum – very junior doctors can do them unsupervised very early in their training) and is lifesaving – you make the hole in the right spot, identify the appendix, tie it off, chop it off and wash out the abdominal cavity with sterile water and then close the hole.

If you have access to intravenous antibiotics the following regimen may be more appropriate than considering an operation – see Chapter 7. But circumstances will vary.

Basic Procedure

1. Completely expose the abdomen and clean with an antiseptic.

2. Draw an imaginary line from the top of the pelvic crest to the middle of the pubic bone. One third of the way up this line from the bottom is where you cut. It approximates McBurney's Point.

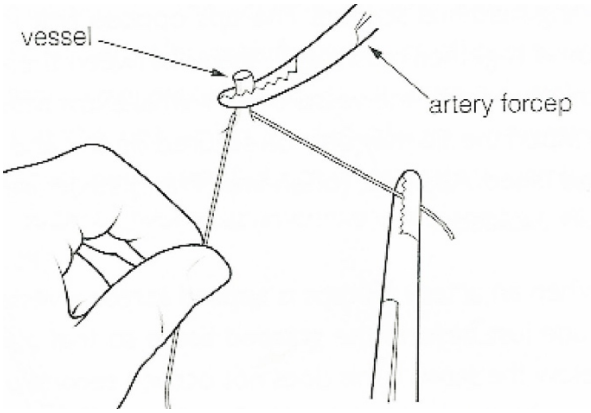
3. Infiltrate the skin and subcutaneous fat with local anesthetic if not using a general anesthetic. Cut a 7-8 cm incision with McBurney's Point acting as the center point. Cut through the skin and fat.

4. After the fat layer you will come to the muscle layer - it is three muscles - but treat it as a single barrier that will have fibers running in different directions. Infiltrate extensively with local anesthetic. Use a small hemostat to pierce this layer and then split the muscle fibers to make a hole of similar size to the skin incision. In most patients, the top layer of muscle may have a canvas-like layer over it and this will need to be cut first.

5. Beneath the muscle layer is the "Glad Wrap-like" peritoneal membrane - it can be punctured with a finger and stretched with two fingers. It is highly innervated and it will be painful. It also has significant parasympathetic innervation and this may cause a bradycardia (slowing of the heart rate) - which should be transitory.

6. Next step is finding the appendix and this may be a challenge. Resist pulling large amounts of bowel out through the incision. Anatomically it should be immediately below your incision - but not always. Come in from the side of the patient and locate the large bowel - follow it to its end where the small bowel plugs into it and there should be the appendix. Sometimes it is tucked up behind the large bowel. Never pull hard on it - gentle tie off any adhesions and cut them to free up the appendix - these can be important steps and you need to take your time.

7. The appendix has a blood vessel running in the lace-like mesentery right next to it - this needs to be clamped and tied off. Use an artery forcep to grab the vessel and clip it – then use suture material to tie under the clip to close it off – repeat it with two separate ties



tying off a blood vessel. Wikipedia.

8. Now tie off the appendix with three ties - place two close together close to the large bowel and the third - 1 cm up the body of the appendix. Cut the appendix between the second and third ties. Replace all the abdominal contents back in the abdominal cavity once you are sure all bleeding is controlled.

9. Irrigate the abdominal cavity with 8-10 liters of boiled, cooled water sucking it out after each liter.

10. Close the muscle layer with 1/0 or 2/0 sized dissolvable sutures and then suture the skin.

Caesarean Section

Another procedure which has been done for centuries with an increasing maternal and fetal survival as aseptic techniques and anesthesia improved is a caesarian section.

Any obstetric textbook contains details of the technique and it is broadly described below. The modifications in an austere environment would be both an up/down midline incision through the skin and muscle and an up/down (or classical incision on the uterus). Again, it is not technically that challenging and potentially lifesaving to both mother and child.

It is indicated in obstructed labor, severe pre-eclampsia and placenta previa. It is not indicated for fetal distress alone as it is to risky to undertake if there is no risk to mother. Sadly, if the risk is only to the baby, it can be allowed to die and then destructively removed if necessary.

Basic Procedure

1. If using a general anaesthetic ignore directions regarding infiltration with local anaesthetic.

2. Clean the entire abdomen with alcohol or betadine. In the absence of either of these use soap and water.

3. Infiltrate local anaesthetic along an imaginary line from just below the belly button to the top of the pubic bone in the midline. Infiltrate down through the skin and subcutaneous fat. Remember the maximum per-kilogram dose of the local anaesthetic you are using

4. Using a scalpel blade, cut through the skin and fat along the same imaginary line until you come a layer which will look like either white canvas or fleshy muscle.

5. Infiltrate more local anaesthetic into the muscle and sheath (canvas-like structure).

6. Using your fingers push in between the two belly muscles in the middle and pull them apart. At the top end of the wound use a sharp pair of scissors to cut the canvas-like sheath.

7. Stretch the muscles apart. This may be very painful even with local infiltration.

8. What you should be looking at now is a thin clear membrane layer lying over what will look like a large pink/purple mass – which is the uterus. Poke a finger through this membrane and stretch it open – again this is likely to be painful.

9. On the lowest part of the uterus, visible in the bottom part of the incision by the pubic bone will be the bladder on the front surface of the uterus. It is very important not to cut this.

10. You need to perform the next step very quickly. Beginning just above the bladder make a long incision to the top of the uterus. Keep cutting until you hit amniotic fluid – and you will get a large gush of fluid. Then extend the incision with scissors taking care not to cut the baby.

If the placenta is attached to the front wall of the uterus you will hit this before you hit amniotic fluid – the placenta will look like hamburger patty – keep cutting until you reach amniotic fluid.

11. Orientate yourself to what part of the baby is where. Usually the head will be down. Try and find the babies feet and pull them into the wound and deliver the rest of the baby. Once the baby is out, it needs to be handed off to an assistant not involved in to operation. Resuscitation of the baby is covered in chapter 12.

12. The placenta can be scooped out of the uterine cavity with the side of your scooped hand.

13. You need to stich the uterus quickly. It will bleed a lot – you need suction and plenty of absorbent gauze. Start at the bottom of the incision with 0/0 or 1/0 nylon and run a continuous stitch from the bottom to the top of the uterus in a single layer. Under ideal circumstances a multi-layer closure is often performed, but here the goal is rapid closure to facilitated haemorrhage control. Once the uterus is closed, gently massage it until it visibly contracts and firms under your hand.

14. Irrigate the abdominal cavity with copious amounts of sterile/boiled normal saline or water and suction it out.

15. Close the muscle layer with a continuous running stitch – it should almost be a layer of canvas in the midline and it is these two edges that should be approximated.

16. The skin can then be closed with sutures or staples.

Ectopic Pregnancy Removal

This again is a condition that has almost a 100% mortality if left untreated. A woman who is in early pregnancy presenting with severe abdominal pain, only minimal vaginal bleeding and severe shock likely has an ectopic pregnancy.

Tubal ectopics can be removed by making a mini-laparotomy incision 5-10 cm long just above the pubic bone (slightly small than the cesarean section incision described above). The offending tube is identified, tied off and removed. Again, this can be life-saving. This technique has been described as been taught to

non-formally trained health assistants in Third World countries and hundreds have been performed under local or ketamine anesthesia without muscle relaxation.

Other Abdominal Surgery?

In addition to the above there are several other procedures, which could be considered. Again, risk is high and needs to be traded off against the risk of not doing something. Working in the abdomen is hard, especially without good general anesthesia and muscle relaxation.

Over-sewing of an ulcer?
Removal of a gangrenous gall bladder?
Repair a nick/small hole on a piece of bowel and wash out the abdomen?

These are operations that are potentially more complicated and riskier than the removal of an appendix or a c-section – however all are for conditions which, if not treated surgically are likely to result in death. Management with high dose antibiotics is a potential option but in these clinical situations, even if large amounts of the appropriate antibiotics are given, they are probably of little use.

Amputation

This procedure has been done for thousands of years, long before local or general anesthetic. The classical description is of the guillotine technique, a straight through technique, however this leaves the bone sticking out (as the muscle and skin contract back) and can be difficult to achieve skin closure. The best technique for austere use is a flap amputation where the skin and muscle is left longer than the cut bone so you can cover the bone end. It is a simple technique and again well covered in texts. There are many indications in the absence of more complicated surgery or antibiotics:

1. Crush or de-gloving injuries
2. Compound fractures
3. Established severe infection
4. Severe full thickness limb burns

The International Committee of the Red Cross has some general observations regarding amputations:

- Field Amputation for war wounds is difficult and different from normal amputations
- The amputation must include all dead, contaminated and contused tissue
- Stump infection is very dangerous
- Use a tourniquet for surgery
- Leave enough soft tissue to cover bone
- Do not underestimate muscle swelling post procedure
- Never attempt primary closure of the stump

This more detailed description is based on the 1982 Edition of the US Special Forces Medical Handbook

The Procedure:

Amputations are performed to save life and are done at the lowest level possible. All attempts should be made to save the knee and elbow joints even if this means having a short stump.

Indications for amputation are:

I. Massive gangrene.

II. Overwhelming local infection that endangers life despite antibiotic therapy and surgical measures.

III. Established death of a limb.

IV. Massive injuries in which structures of the limb are obviously non-viable.

V. Secondary haemorrhage.

VI. Extremities with severe involvement of the skin, muscle, and bone with anaesthetic terminus or irreparable nerve injury.

Under combat conditions the most acceptable form of amputation is the open circular technique.

1. A circumferential incision is made through the skin and deep fascia at the lowest viable level. This layer is allowed to retract.

2. The muscle bundles are exposed and then divided circumferentially at the new level of the skin edge. The muscle bundles will then promptly retract exposing the bone.

3. Upward pressure is placed on the proximal muscle stump and the bone is transected at a still higher level. The surgical wound will have the appearance of an inverted cone.

4. Blood vessels are isolated, clamped, and ligated as they are encountered. Bone wax is applied to the open ends of bone to prevent oozing.

5. Major nerves are transacted at the highest level possible.

6. Never close an amputation primarily.

7. Cold injuries are not indications for amputation – wait until the edges demarcate.

A layer of fine mesh gauze is placed over the wound and the recess is packed loosely with fluffed gauze. A stockinet is the applied over the stump securing the stockinet above the stump using adhesive. The

stump is wrapped with ace wraps using compression decreasing proximally and 2-2.5 kg (4.4-5.5 lbs) of traction are applied. Continued traction will result in secondary skin closure over the stump.

Skin Excisions/Lumps

Small skin lesions and lumps under the skin are common. The majority requires no action, however some such as skin cancers and even breast lumps may be cancerous and need removal. They are easily removed without great technical effort – mostly; and can be done under local anesthesia. The major problem for the inexperienced is poor cosmetic result due to technique or damage to surrounding structures such as nerves. But both complications are of limited relevance in prolonged catastrophic disaster.

3. Post-Operative Care

Once you have completed the procedure and the patient has awakened from any anaesthetic they need focused nursing for a few days.

The key issues:

Analgesia: Use what you have but regular (even very basic) pain relief makes a difference to speed of recovery and (obviously) comfort. Good analgesia helps taking deep breaths and this is important to prevent post operation chest infections

Infection: Modern surgery doesn't routinely require antibiotics. Sometimes for more high-risk procedures they are given or a single dose is given during the procedure but in the circumstances, we are talking about if you have them (see antibiotic chapter), a dose of appropriate antibiotics before, during, and after is indicated.

Mobilising: Early mobilising is important. It helps to reduce many of the potential side effects including chest infections and pulmonary embolism from clots. Don't rush the patient and cause agony but they need to slowly mobilise gently as early as possible. Coordinate mobilising with analgesia administration.

Nutrition: Small sips of water should be started immediately and nutrient broth the following day as tolerated. After an operation, the body needs nutrition to repair itself. Historically we always avoided feeding people for a few days – but as our knowledge has evolved over the last 20 years it has become apparent that early nutrition is very important for wound healing.

Basic nursing is discussed in more detailed in the Nursing chapter.

4. Surgical Instruments

Commonly asked questions relate specifically to surgical instruments, and what and how many of them are required for various levels of surgical procedures. Below is a detailed list of surgical instruments with 4 levels of increasing complexity. Note that each level builds on the one before it. This instrument list reflects our own preferences and experience under austere conditions. There are many other instruments that would be helpful (for example ring forceps to hold sponges, larger retractors, etc.), but they are not considered vital. This is the bare minimum.

Quality

The price of a single instrument can vary from $5 through to $500 for what looks like the same instrument? So why the different price?

- Quality of the build – while it may look the same they are not necessarily of the same quality – look to see if the teeth of forceps line up properly, is the grid pattern on the teeth of the needle holder nice and straight, when closed do they line up against each other, are the screws loose? Are they tight?

- Quality of the steel – in some poor quality instruments the steel is so soft you can indent it with your finger nail – that doesn't bode well for the life of the instrument.

- Place of manufacture – a German made instrument is going to be more than a Pakistani instrument – potentially they may be of the same quality. But the lack of quality control and reliable supply lines in Pakistan make German instruments more predictable in terms of quality.

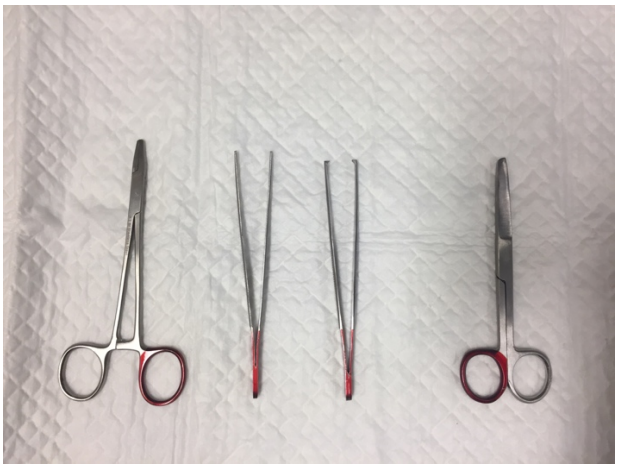
- Reusable vs. disposable – disposable instruments will be of lower quality than one which is designed for reuse. Frequently attempts to resterilise these instruments will damage them and render them useless.

For most people spending $500 on a single instrument is complete waste of time – however it is equally foolish to buy cheap or disposable instruments. It is possible to get quality instruments for approximately for $15-30 USD each. Consider the issues raised above when choosing your instruments.

What instrument is it?

Needle holders – shaped like scissors but instead of having a cutting surface they have two opposed plates with groves cut into them, and are designed to hold the needle, and stop it rolling or slipping as you sew. Once you have gripped the needle, a ratchet holds the tips locked so the needle does not move

Haemostats/Clips/Clamps – Similar in shape to needle holders but the tips are designed to clamp onto tissue and to hold it. They have the same ratchet mechanism to keep them locked and attached once they are attached. They are used to clip bleeding blood vessels or hold onto tissues you are working with. There is a massive range of sizes and shapes depending on what they are designed to clip or clamp.



A disposable suture set – showing (from Lt to Rt) a needle holder toothed and un-toothed forceps and scissors

Clamps in various sizes

Forceps/Dissectors – are shaped like traditional tweezers and come in various sizes. They either have small teeth on their tips or are smooth tipped. They are designed to handle tissues and to help you move tissues round such as when suturing.

Scissors – these are self-explanatory but are the one instrument that gets even experienced clinicians into trouble. Remember; do not cut what you cannot see. Use blunt (versus sharp point) scissors in dangerous places. Do not use scissors that are longer than your haemostats or you risk cutting something you cannot adequately clamp. Mayo and Metzenbaum scissors are for cutting tissue only - do not use them for anything else such as cutting dressings or sutures. Buy good quality scissors and take care of them, as they will stay sharper longer and cause less aggravation when conducting austere surgery.

Retractors – these are designed to hold tissues out of the way so that you can see what you are doing. They come in a huge range of sizes and shapes depending on what part of the body you are working with. Skin hooks or small right-angle retractors are most suitable for most minor wound repairs.

Level 1 - Field Wound Repair Kit:

This is a minimal cost unit intended to be carried in a kit or pack, and be used for minor wound debridement, and closure of the types of injuries most commonly occurring. Although it is a pre-packaged “disposable” kit the instruments may be reused many times with appropriate sterilization and care. This easily goes in a zip lockbag, and can be widely distributed, and available among your group.

1 Tube Super-glue Gel
1 Steri-Strips, and benzoin adhesive, or duct tape
1 Betadine swab packet, or skin cleaner of choice
1 Irrigation syringe and ability to purify at least 2 litters water; tablets, etc.
1 Dressings of choice

Optional items to consider include:

1 Disposable laceration tray with needle driver, pick-ups, scissors, 4x4s, drape
1 Disposable scalpel, #10
1 Ethilon, or Prolene, or silk 4-0 & 6-0 with cuticular needles
1 Vicryl or Chromic Gut 4-0 with cuticular needles
1 skin stapler, 15 shot
1 staple remover
1 Sterile gloves your size
1 Lidocaine 1% or 2% WITHOUT epinephrine

Level 2 - Basic Suture Kit:

This is composed of good quality instruments intended for long term use and re-sterilisation. It is suitable for repair and debridement of minor wounds and injuries including simple two-layer closure. This is typical of much wound care done in a hospital emergency department.

1 Tube Super-glue Gel
1 Steri-Strips, and benzoin adhesive, or duct tape
1 Betadine swab packet, or skin cleaner of choice
1 Irrigation syringe and ability to purify at least 2 litters water; tablets, etc.
1 Dressings of choice
Optional items to consider include:
1 Disposable laceration tray with needle driver, pick-ups, scissors, 4x4s, drape
1 Disposable scalpel, #10
1 Ethilon, or Prolene, or silk 4-0 & 6-0
1 Vicryl or Chromic Gut 4-0
1 skin stapler, 15 shot
1 staple remover
1 Sterile gloves your size
1 Lidocaine 1% or 2% WITHOUT epinephrine
1 Needle driver, 5”
1 Adson forceps,1x2 teeth
1 Sharp/blunt scissors, 5” straight
1 Iris tissue scissors, curved
1 Mosquito hemostat, curved
1 #3 Scalpel handle & #10, #11, #15 sterile blades
Ethilon, or Prolene, or silk suture; 2-0, 4-0, 6-0, cuticular needles
Vicryl or Chromic Gut suture 2-0, 4-0, 6-0 cuticular needles
Skin staplers and remover
Steri-Strips and benzoin
Several tubes Super-glue Gel
Skin cleaner of choice
Irrigation syringes and ability to purify water
Sterile gloves appropriate sizes
Sterile drapes, disposable or reusable
Appropriate anaesthesia and dressing of choice

Level 3 - Procedure Kit:

This kit is capable of complicated multilayer wound repair, basic obstetric repairs, plastic surgery closures, tendon repair, chest tube insertion. This is suitable for laymen with some training and experience, and is probably the recommended level for most as it has the greatest capability vs. expense. Those with adequate medical training could press this into service for more advanced problems with some improvisation. Note: if you anticipate a lot of obstetrics or foreign body removal a Weitlaner

retractor, 5-6" would be very helpful. A rongeur and rasp are very helpful for bone clean up, traumatic finger amputations, etc.

1 Needle driver, 4-5"
1 Needle driver, 6-7"
1 Sharp/blunt scissors, 5" straight
1 Baby Metzenbaum or Mayo scissors ,5" curved
1 Iris tissue scissors, curved
1 Mosquito haemostat, straight
1 Mosquito haemostat, curved
1 Kelly haemostat, straight
1 Kelly haemostat, curved
1 Peon or Oschner haemostat; 7-8", curved
1 Adson forceps, 1x2 teeth
1 Adson forceps, no teeth
1 Splinter forceps
1 Senn 3 prong/blunt + right-angle double end retractor
1 Allis 4x5 clamp
2 #3 Scalpel handle and #10, #11, #15 blades
1 #4 Scalpel handle and #20 or #22 blades
1 Thin probe
Ethilon, or Prolene, or silk suture; 0, 2-0, 4-0, 5-0, 6-0, 7-0 cuticular & plastic needles
Vicryl or Chromic Gut suture; 0, 2-0, 4-0, 6-0 cuticular needles
Skin staplers and remover
Steri-Strips and benzoin
Several tubes Super-glue Gel
Skin cleaner of choice
Irrigation syringes and ability to purify water
Sterile gloves appropriate sizes
Sterile drapes, disposable or reusable
Appropriate anaesthesia and dressing of choice

Level 4 - Major Procedures Kit:

This kit is capable of complicated multilayer wound repair, obstetric repairs, plastic surgery closures, tendon repair, chest tube insertion, emergency abdominal surgery, Caesarean sections, straightforward amputations, etc. With this kit a competent practitioner should be able to perform all the procedures that are likely to be possible in an austere environment.

1 Needle driver, 4-5"
1 Needle driver, 6-7"
1 Sharp/blunt scissors, 5" straight
2 Baby Metzenbaum or Mayo scissors, 5" curved
1 Metzenbaum, 6-7" Curved

1 Mayo, 6-7" Curved
1 Iris tissue scissors, curved
1 Mosquito haemostat, straight
1 Mosquito haemostat, curved
2 Kelly haemostat, straight
2 Kelly haemostat, curved
2 Peon or Oschner haemostat, 7-8" curved
1 Adson Forceps, 1x2 teeth
1 Adson Forceps, no teeth
1 Splinter forceps
1 Russian forceps, 6-7"
2 Senn 3 prong/blunt + right-angle double end retractor
2 Allis 4x5 clamp
1 Army-Navy retractor
1 Ribbon retractor
1 Weitlaner retractor
2 #3 Scalpel handle and #10, #11, #15 blades
1 #4 Scalpel handle and #20 or #22 blades
1 Thin probe
1 Wire (Gigli) amputation saw or Satterlee amputation saw
1 Adson type bone rongeur
1 Bone rasp
Ethilon, or Prolene, or silk suture; 0, 2-0, 4-0, 5-0, 6-0, 7-0 cuticular, taper, & plastic needles
Vicryl or Chromic suture; 0, 2-0, 4-0, 6-0 cuticular & taper needles
Skin staplers & remover
Steri-Strips and benzoin
Several tubes Super-glue Gel
Skin cleaner of choice
Irrigation syringes & ability to purify water
Sterile gloves appropriate sizes
Sterile drapes, disposable or reusable
Appropriate anaesthesia and dressings of choice

Summary:

"First do no harm". This is always the starting point. At first glance suggesting lay people undertake surgical procedures sounds only marginally short of madness. However, when you consider there is a significant group of conditions for which if a surgical procedure is not undertaken the person will die, then it changes the dynamic of your decision making: if one option is 100% death and the alternative is only 90% - then what do you choose? What about if the chance of survival is 80% or 60% or 40% then surely you have an obligation to try? Survival rates 200 years ago for procedures such as the ones discussed were surprisingly high and the quality of many of the surgeons was very poor and knowledge of antisepsis, wound healing or anaesthesia was low to non-existent.

Know the risks vs. benefits.
Know the anatomy.
Know the procedure.
Maintain sterility and antisepsis as best as you possibly can.
Provide the best anaesthetic your skills and stores allow.

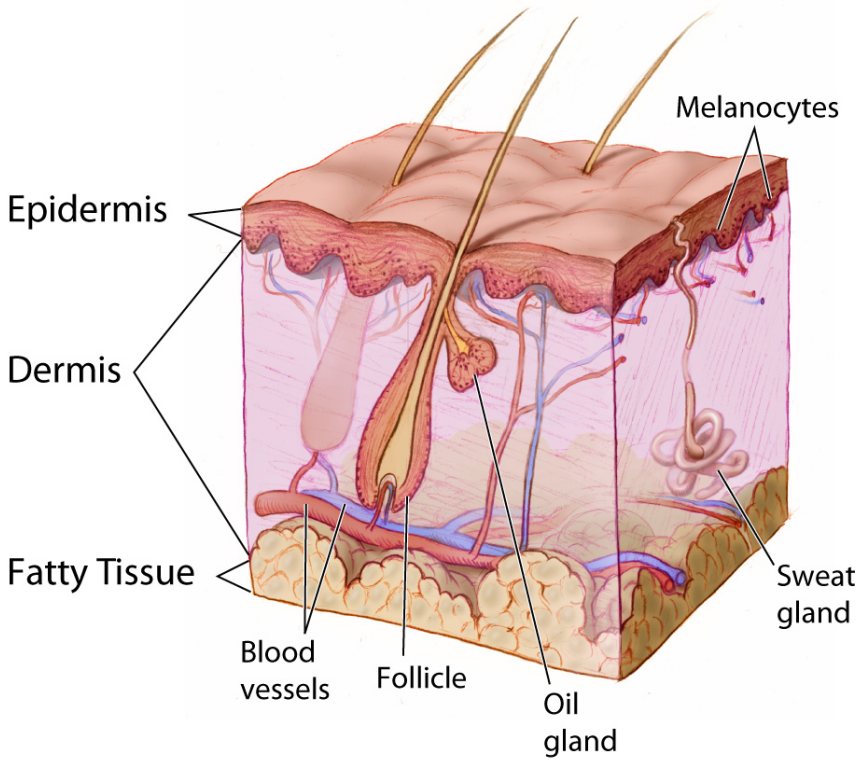
Circumstances dictate what is an acceptable risk. Nothing is absolute

Chapter 11 Wounds and Wound Closure

a. Anatomy

To manage wounds first you need to understand the function and anatomy of the skin and subcutaneous layers.

The Integumentary System



The skin is vitally important to us aside from keeping all our bits inside it.

It is the largest organ of the body.
It is the least appreciated.
It is a protective layer.
It provides us with our sensation.
It is a natural air conditioner – radiating heat and containing it.

The skin has 2 specific layers, plus the subcutaneous layer beneath them.

Epidermis

This is the first and outmost layer and consists of dead or dying cells.
Combined with **sebum** (oily material produced by glands in the dermis) it provides a water tight and pliable seal.
It is made of stratified squamous epithelium.

Dermis

This is the true skin.
It produces the epidermis and is constantly regenerating.
It houses the blood vessels and nerves associated with the skin.

Subcutaneous tissue

This lies under the skin and between the bone and muscle structures underneath. It is mostly composed of fat and loose connective tissue. It provides insulation and layer for bigger nerves and blood vessels to run in and has a further role in temperature regulation.

b. Wound Healing

A simple understanding of wound healing is as important as understanding the anatomy. This knowledge can help you decide when and how to close the wound and how long the sutures need to stay in for. The basic process is:

The wound occurs and fills with blood clot (hrs.)
The blood clot becomes organized and stable (hrs.)
Inflammatory cells migrate into wound edges and "eat" damaged cells and debris (12-72hrs)
Epithelial cells begin to migrate onto clot (1-7 days)
Connective tissue cells migrate into clot (3-30 days)
The connective tissue cells begin to produce collagen which provides strength to the wound (Peak production 7 days)
Maximum strength not reached for 3-6 months

There are many factors that influence poor healing and you need to consider these as part of the decision to close. Patients who are likely to heal poorly, may be better off left with the wound open to heal by secondary intention. These factors include poor wound repair, excessive skin tension, advanced age, alcohol abuse, diabetes, severe anemia, steroids and long term anti-inflammatory drugs.

c. Types of Wounds:

Tissue injuries are caused by two different mechanisms:

- Direct traumatic injury – either blunt force or penetrating force.
- Burns – these are discussed in the Clinical FAQ.

i. Contusions (a bruise)

These are blunt, non-penetrating injuries, caused by a direct blow to the skin that crush the tissue and damage small blood vessels. Initially you see erythema (redness) that results from the dilation and leakage of the capillaries, the classical bruised (ecchymosis) appearance as the blood loses it oxygen. If a substantial amount of blood leaks out, a hematoma forms – this is where blood leaks out of vessels and pools usually under the skin. The patient can lose a significant amount of blood before swelling is evident and this should be considered in a patient presenting with shock.

Normally contusions are just painful and analgesia is usually all that is required. On occasions a large hematoma has the potential to get infected. Classically you would see an increasing pain, increased swelling and fever. Treatment should be with antibiotics, if not quickly setting, an incision and drainage may be required.

ii. Abrasion (a graze)

This is an open wound where the superficial layers of the skin have been "abraded". They are usually minor – and simply require a thorough cleaning to remove any debris. Small abrasions generally do not require a dressing – but expect the wound to ooze. Larger wounds will benefit from a non-adhesive dressing.
An abrasion
It can potentially be a problem if it involves a large surface area – it should still be cleaned, but treated as a partial thickness burn if > 10% body surface area.

iii. Lacerations (a cut)

A laceration is an open wound through the skin down into deeper tissues. Generally, it involves a small surface but there is potential damage to deeper structures such as nerves and blood vessels. Laceration-type wounds are classical types of wounds we are talking about when we are considering closing a wound.

An incision is a "surgical" laceration – a straight linear incision usually caused by a knife or glass.

iv. Puncture wounds

Puncture wounds are characterised by small surface wounds (created by a nail or a low-velocity bullet) that penetrate the deeper layers. There is a risk of injury to deeper structures and the risk of infection when foreign material or dead tissue is inoculated into the deeper tissues.

Puncture wounds to the foot are very common, classically standing on a nail. The austere treatment involves a thorough cleaning of the wound, washing out deep into the wound as best as possible. Generally, treat treatment is with antibiotics such as Amoxicillin and Clavulanic acid or Co-trimoxazole. If the wound/foot becomes swollen and there is increasing pain despite antibiotics, if possible, switch to intravenous antibiotics. If this does not work or is not available, then the treatment is to lay open the wound and wash out and debride it – and not suture it but leave it open to drain.

v. Avulsion wounds

An avulsion wound occurs when the skin is avulsed off the underlying structures creating a flap or resulting in complete skin loss. The skin is generally pushed up against one side of the wound. These are the sorts of wounds that you see when you badly graze your shin or your skin gets torn on a sharp edge of something and torn away.

Severity is dependent on:

- Surface area
- Origin of circulation into the flap created – a proximal (closer to the heart) is better than a distal flap – where the blood must travel around the wound and back into the flap to supply the flap.

In terms of treatment: Clean the wound well. Try and stretch any remaining skin across the exposed area. If the flap is meaty and the skin mostly covers the wound it can be sutured. If the flap is thin and superficial (usually seen in the elderly), the skin edges don't tolerate suturing well – because of the thin flap and poor blood supply – so once approximated they should be secured with steri-strips rather than sutures.

With both types, a firm pressure dressing should be applied and the limb should be elevated for 48 hours.

vi. De-gloving injuries

A de-gloving injury is a variation on an avulsion – but is a bigger and more destructive injury with both extensive loss and destruction of skin and subcutaneous structures – the overlying tissue is sheared off the underlying structures that are often damaged as well.

The sort of injuries is seen when a limb is run over, caught in machinery or injured in an explosion. If minor, it should be treated as an avulsion. With a major de-gloving injury, the likely outcome is amputation.

vii. Amputation

An amputation is the traumatic complete removal of part of an extremity. This can vary from a fingertip to the entire limb. A tourniquet should be placed as distally (towards the end of the limb) to the amputation site as possible to control bleeding.

In an austere situation, there is no option but to tidy the bone end up if exposed, trim any jagged tissues and close the wound.

If there is access to health care, wrap in amputated part in wet gauze, place in a plastic bag and place the plastic bag in a slurry of ice and water and transport urgently to a hospital.

viii. Gun-shot wounds

Gunshot wounds are discussed in more detail in the Clinical FAQ chapter. In summary:
Low velocity: Usually minimal tissue damage
High velocity: Major tissue damage
Shotgun: Unless point blank range, tend to behave like multiple low velocity

Basics of care:

A hole going in → lots of damage done → +/- a hole going out (+/-).
What gets damaged depends on the path of the bullet. It comes back to anatomy, ask yourself the question: What could have been damaged?
Remember bullets bounce off bone.
It is not always a linear path between entrance and exit wounds.

Low and high velocity GSW's:

- Control hemorrhage.
- Debridement of the wound.
- Pack the wound with gauze.
- Wait 48hrs.
- Further debridement.
- Consider closing the wound if clean or repeat packing.
- This broad approach works well for limbs – with wounds to the head/trunk there is likely to be major damage to vital organs and you are limited as to what can be done.

Shotgun wounds:

- If shotgun was a close range treat as if it is high velocity wound.
- Otherwise ggenerally do nothing to wounds - clean and dress and dress them.
- Treat any complication such as bleeding or a pneumothorax.
- As with other sorts of GSWs it is not possible in an austere environment to fix damage to major organs.

It is not overly important to try to remove the bullet fragments. If you see them on debridement, remove them, but don't spend time and damage tissue to find them.

ix. Stab wounds

Usually a stab wound is only a small wound(s). Managing at a skin level is relatively simple – they usually only require a few stiches or some glue. The problem is the damage done to underlying structures.

When the stab wound is on the limbs the management is relatively straightforward. Control hemorrhage, repair any structures you can and close the wound (this broad process is discussed next in this chapter).

If the stab wound is on the chest or abdomen the option of repairing any damaged structures generally is not an option. A simple pneumothorax (punctured lung) can be safely managed by simply closing the wound and applying and airtight dressing (discussed in Chapter 6). Injuries to other organs and structures are essentially not manageable in an austere situation. The wound should be washed out and closed. The patient will either make a recovery or they will not.

x. Evisceration

Evisceration is a special type of penetrating injury where the abdominal cavity has been opened and the abdominal contents come out through the wound. This is likely a fatal injury without complicated surgery and antibiotics.

In an austere situation initially cover the guts with a with a sterile/clean moist dressing. The goal is to keep them clean and damp. It is possible to attempt to replace them in an austere situation, but the death rate may be high.

You will need to extend the initial incision, wash out the abdominal cavity with sterile water (5-6L of sterile water or normal saline), inspect the bowel for any damage (and repair if technically possible), replace the bowel and close the wound. On occasions the bowel will become swollen the longer it is outside the body so replacement may be difficult. If available the patient should be started on Amoxicillin and Metronidazole.

xi. War injuries

Most wounds you will deal with in an austere or survival situation will largely be due to workplace or home injuries. Contrary to some views it will be relatively unusual to encounter injuries or wounds as a direct result of battle or war injuries.

By understanding who dies from war wounds, it enables you to focus on what is correctable from a treatment perspective

Deaths

- Haemorrhage: 85%
  - >50% of this group had extremity injuries
- Tension Pneumothorax: 12%
- Penetrating Head: 2%

- All other injuries: <1%
  - (C Spine, Tamponade, Airway injuries)

Of these deaths, up to 60% of deaths were considered preventable. The three most common causes of preventable death were: airway obstruction, tension pneumothorax and extremity hemorrhage. Each of these has a specific treatment: - airway management, up to and including a surgical airway, decompression of the pneumothorax and application of an extremity tourniquet and potentially an amputation. Each will require some definitive care – but it is possible to provide this for many individuals in an austere environment.

xii. Bite wounds

The same general points apply for all bites:

- Good cleaning and debridement vital
- Generally, do not close bites primarily – that requires considerable experience to pick the right bites to close – so best leave them open to heal from the bottom up – secondary intention.
  - Either secondary closure or delayed primary – discussed later in this chapter.
- Always look for/examine for foreign bodies. Specifically, for pieces of teeth
- Dogs and bats (in particular – in theory any mammal can do it) pose a risk of transmission of rabies and this is discussed in the following section.

Dog bites

There are usually superficial but with degree of shearing and only require simple cleaning. They rarely involve muscle, although in a prolonged attach by a big dog they can occur. Children more at risk to die do to smaller size. The infection risk is no greater than normal wounds – despite popular opinion – although they do require a thorough cleaning and potentially debridement. Prophylactic antibiotics are not required unless high risk:

- Significant crush damage
- Hand
- Diabetic
- Elderly
- Immune compromised

The management of dog bites consists of copious irrigation with water, debridement of damaged tissue and leaving the wound to heal by secondary closure.
If the wound becomes infected, it is frequently poly-microbial (there are several different bacteria causing the infection). Good antibiotic choices include Amoxicillin and clavulanic acid and Doxycycline

Cat bites

These are usually single or several puncture wounds and there is a risk of penetration into deeper structures with "seeding" of bacteria. They have a relatively high risk of infection – thought to be about 30+% - although many cat bites never get to a hospital so a true percentage is hard to determine. The commonest bug is known as Pastuella, although these are still frequently poly-microbial.
Management consists of a good cleaning with soap and water. Usually they are puncture wounds so do not need closure. If it is a laceration type wounds, DO NOT close. Infection is common – so it is reasonable to treat prophylactically (before signs of infection) with antibiotics. The antibiotics are the

same as for dog bites and the same for prophylactic and treatment. Infection in deeper tissues (or if no antibiotics) may require incision and drainage or opening and washing out

Rodents
Such as rats or ferrets have a low infection rate. They have small jaws and teeth and usually cause minimal tissue damage. All they need is a good cleaning. In the rare event, they become infected the same antibiotics as for dog bites are appropriate.

Bats
Bats are common biters but rarely cause bacterial infections. The wound needs a good cleaning. If signs of local infection are present then a course of the same antibiotics as above are indicated.

Human bites "The Worst"
Human mouths are filthy and the nature of human bites – often deep and violent or into the joint spaces of knuckles during fistfights produce nasty infections.
Not all human bites are bad, childhood nips that seldom break the skin or seed bacteria deeply are rarely a problem and infection is rare and just requires a cleaning.
Adults fighting produce the worst bite, especially hand injuries. Infections are very common
The management of human bites consists of:

- If on the limbs:
  Clean and debride
  No primary closure
  Prophylactic antibiotics if available
- If on the hands/face:
  Often there is penetration into deeper structures such as joints, tendons or ducts.
  These require a through cleaning and wash out and antibiotic therapy if available.

Rabies

Rabies is endemic (widespread) in many parts of the world. Vaccination is an option if traveling in endemic countries. It is caused by a virus that attacks the central nervous system of potentially any warm-blooded animal, but is most commonly found in populations of dogs, raccoons, and bats.
It has an incubation period of 2-8 weeks – there are rare cases of it presenting several years after exposure.

If you are bitten by a possible rabid animal, if possible the animal should be caught and observed. Rabid animals are only infective in the last few days prior to death. Observe the animal and if it doesn't die within 10 days = no rabies.

The treatment is treatment with rabies immunoglobulin and vaccination neither of which is likely to be available.

Austere management of a rabies prone wound is a through washing with soap and water, this significantly reduces infection rates when bitten by rabid animal.

D. General Wound Management:

The basics of wound management are very similar regardless of the size of the wound. Big or small; knife or bullet, there are several components or requirements that are always the same:

1. Lighting
2. Exposure
3. Assessment of injured structures
    a. Nerves/nerves / blood vessels/tendons/organs
4. Anesthesia of the area – if available
5. Decontamination
6. Debridement
7. Closing the wound – or not based on your assessment of it
8. Consideration of the need for antibiotics

1. Lighting

You need to have good lighting to see what is going on in the wound. It seems whatever position you put yourself in your shadow blocks your light source and the wound appear in shadow. The answer is a good quality head torch – preferably one that can adjust focal depth.

Another option is an Ear-Nose-Throat mirror, which reflects available light directly in line with your own vision. There can be improvised – take a woman's make-up (concave) mirror and drill a hole in the middle – you can then make a harness for wearing over your eye and can direct light onto it and reflex it into the wound.

2. Exposure

The whole area needs to be exposed. Remove clothing. Clean off any dirt or blood. If the wound is on a hairy part of the body, then the hair around the wound should be trimmed short, so the wound can be clearly visualized. It is important not to shave the skin around the wound as shaving causes small nicks in the skin and pre-disposes to infection.

3. Assessment

For every wound, the basic process is always the same.

Assess that the structures distal to (further along the limb or below) the wound are working. This is where a knowledge of anatomy becomes vital. You must know what is normal function looks like and what structures are in and around the wound.

- Tendons
    - Are any of the tendons cut?
    - Can all the distal joints work normally?

- Nerves
    - Is sensation intact distal to the wound?

- Blood vessels
    - Are there good pulses?
    - What is the capillary return?

4. Local Anesthesia

This is discussed in detail in the Anesthesia chapter.

5. Decontamination

Through cleaning is the best way to reduce chance of wound infection. Traditionally, when repairing and handling a wound, we have used sterile gloves, there is now good evidence that there is no difference in wound infection rates between sterile and non-sterile gloves. There is only a small increase in infection rates when using no gloves with well washed hands.

There are two broad phases to decontaminating a wound:

1. Cleaning
2. Irrigation

Cleaning:

The initial step is the process of removing visible dirt and contamination. Clean water is fine for the cleaning and irrigation of wounds. Frequently a antiseptic is added to the water, but is not vital.

Common antiseptics include –

Povidone/Iodine
Chlorhexidine
H2O2
Alcohol (very painful in wounds)

The latter two both can have some toxic effect on cells in the wound edges and some authors advocate avoiding these entirely due to the damage they can do to tissue – and this is probably reasonable advice if there is an alternative, particularly if using neat/concentrated solutions of them. However dilute solutions of both are useful and the benefit, particularly in the absence of a very clean water supply, exceeds the risk.

You should wipe away any visible dirt and contamination in a circular motion. Start by wiping the wound itself, and then move in a circle carrying dirt away from the wound. Clean at least 2-3 inches away from the wound.

Irrigation:

The solution to pollution is dilution. Large volumes are used to wash out and dilute any microscopic contaminates in the wound.

Sterile normal saline is the first preference, but clean tap water is adequate and in a First World setting there does not appear to be any difference between the two. A safe source of water for wound irrigation in an austere environment of the Third World can be more challenging. The first step is to assess the threat the local water poses, understand the potential pathogens in your source water and how to treat them. Well water can be used or tap water but it must be clean. Sand filtering and boiling or cleaned with formal water filters are generally required. If high micron filtration isn't available, following sand filtration and boiling a halogen such as iodine or chlorine can provide a secondary treatment.

Ideally the irrigation needs to occur under pressure (7-20 psi) and be of an adequate (100-1000 mL) depending on type and level of contamination of the wound. A simple method to achieve this pressure is to use a 60 cc syringe with 18-gauge needle on it and force the irrigation solution out with pressure. Use this pressured spray to lavage the wound and dislodge bacteria and debris.

6. Debridement:

The basic problem with wounds and closure is this basic equation, dead tissue = rots = infection = bad.

Debridement = removal of dead and seriously damaged tissue.

For most wounds, it is simply a case removing small amounts of obviously dead or devitalized tissue but in some wounds, can be extensive. The goal is to remove enough tissue not to have infective foci, but minimize excision of healthy tissue. It can take up to 24 hours for dead and dying tissue to demarcate so often it is a good idea not to do any significant debridement at the first look at the wound.

Debridement is not a difficult process, but it does require you to be patient and meticulous in your procedure.

Once you have stopped bleeding from a wound your next goal is to prevent infection. Debridement really is just removing all the junk (foreign bodies, dead tissue, dead muscle, non-vascular bone fragments, dirt, grass, rocks, dried blood, etc.) from the wound so that it does not provide an ideal medium for bacteria to grow.

For the beginner, you need lots of sterile water, a 60 cc syringe, a scalpel (#10), toothed forceps, retractor, tissue scissors (Metzenbaum type), good lighting and a comfortable chair/position as you will be at it for some time. As you get more advanced you will want to add to your toolbox such things as a bone curette, hemostats and absorbable ligature material, and maybe diathermy.

Irrigate the wound with a syringe and some pressure with lots of solution (100cc per100 cc per inch of

wound per hour-old is one commonly used calculation). Dry it out and then work from top to bottom removing the badness either through picking it out or cutting it out. When all is done and you think you have an area of healthy issue with good blood supply irrigate one more time, dry and dress the wound per the instruction above. In a few days, you will see if you got everything and can close via delayed primary closure or the wound will be infected. If you close the wound at the time of debridement, there is a much greater risk of developing an abscess in the wound.

The amateur mistakes are either taking too much viable tissue via excess excision thereby increasing the potential for deformity and disability or not getting all the badness out and an infection resulting. With enough practice, you will find the correct balance.

You can practice this somewhat by taking a piece of meat (a fresh pork shoulder roast with skin attached works well), cutting a wound and adding dirt and debris (or blasting it with a firework) and then taking your instruments and going to work debriding. After practice, the roast will make a good Sunday Dinner.

Debridement is discussed in more detail in the Surgical Procedure chapter.

7. Closing a Wound:

Stitching up gaping cuts in the bush with your darning needle and fishing line are the stuff that great stories are made of. Certainly, this can be effective, but like anything it carries a risk of harm if not done properly; poor healing, infection, and reactions to the suture material can occur.

Lots of wounds are not suitable for suturing - that may include deep abrasions and puncture wounds or wounds where there has been extensive skin loss and are not suitable to suture – due to age or contamination. Many wounds that we currently suture will heal very well without any intervention. Suturing is mostly done to speed up wound healing and for cosmetic reasons. Before you perform any surgical procedure, you need to weigh the benefits versus the risks; suturing is no different - first do no harm.

What we will cover first is making the decision to close a wound in the austere environment and then we will address basic wound closure using suture and alternative methods.

For an in-depth discussion on suturing, we recommend the 2007 Ethicon “Wound Closure Manual” (which you can download from Ethicon) or an edition of “Wounds and Lacerations: Emergency Care and Closure” by Trott, both of which are excellent reads for persons undertaking these skills at all skill levels. Several other books listed in the Reference section provide detailed instruction on suture technique.

At the end of this chapter we will look in more detail at suture materials and needles so you can decide what should be in your medical equipment holdings.

The decision to close a wound

The hardest part of suturing is asking "should I close this wound?" followed closely by "how should I close this wound?" The error that most clinicians make is closing a wound that should not be closed or is not ready for closure due to poor wound preparation. Suturing is a bit like painting a house; the product is contingent on sound preparation of the surface to be painted prior to brushing on the paint.

Before we get started there are three concepts of wound closure you need to be knowledgeable about. These are primary closure (primary intention), secondary closure (secondary intention) and tertiary closure (delayed primary closure). Primary closure is the one you are likely most familiar with; it is sewing up the wound as soon as possible post injury. Closure by secondary intention sees the wound not closed, but rather allowed to heal by granulation and reepithelialisation. Finally, delayed primary closure sees the wound left to “resolve” over a 3 to 5-day period where, once you are sure no infection is present, it is closed.

Once you have determined that a wound should be closed, the first question you should ask yourself is, "is this the proper time to close this wound?" Not all wounds should be closed primarily! From the minute a wound occurs, the chance at developing an infection increases as time moves on. The longer it takes from wounding to primary closure, the higher the risk of infection. The “golden rule” is often cited as 6 to 8 hours from time of injury for an uncomplicated laceration. After this, the risk of a wound infection under the primary closure is thought to be too high to warrant stitching up. This rule hinges on several factors decreasing the time allowable for wound closure (such as gross wound contamination) or increasing the time allowable for wound closure (such as body location). If you can get a wound to stop bleeding, remove all devitalized tissue, and ensure no contamination is inside the wound, it is a candidate for primary closure.

In situations such as skin infections, abscesses, wound cavities, punctures, ulcers, animal bites, burns, and situations where you have notable tissue loss then it is not a good idea to attempt to close the wound. Rather clean it, debride it, consider antibiotics, and provide wound care thereby allowing it is heal on its own by secondary intention.

Finally, wounds that are dirty and likely have a high bacterial count (most war wounds for instance) should not be closed right away but rather by delayed primary closure. Clean them, debride them, consider antibiotics, and provide wound care for 4 to 5 days. After the clock runs out (you have up to 7 days) inspect the wound carefully and if you are convinced no infection is hiding in the wound then close it, like you would have done primarily. The wound should be clean and red with minor bleeding that indicates early granulation tissue formation. If you examine the dressing from deep in the wound, the exudate (the ooze from the wound) in it has dried to the dressing and it is hard like plaster of Paris. The dressing gauze on the raw wound is adherent and resistant to being peeled off. The wound is not ready to close if the casualty has a fever, a wet dressing that “floats off”, is shiny with or without pus on inspection, has no bleeding, and contains dead muscle or frank skin erythema (redness). It is not possible to close a wound primarily after 8 days because of fibrosis. At this point you just allow the wound to heal by secondary intention.

The next question you should ask yourself is, "can I explore and clean this wound?" If you cannot visualize the wound due to poor lighting, lack of skill, or instrumentation and/or do not have the ability

to debride and irrigate the wound then you should not close it due to the risk of infection post-closure of a dirty wound.

The next question you should ask yourself is, "is this wound still actively bleeding?" For the survival medicine clinician, it is likely not a great idea to close a wound that is still bleeding in any great amount. It is all right to close a wound with the most modest of bleeding and in those situations where you are using closure for significant haemorrhage control. Gain bleeding control through ligature and direct pressure prior to closing. Active bleeding under the suture line can continue to bleed and a blood clot under the suture line risks poor closure results and infection.

The next question you should ask yourself is, "do I have the right material to close the wound?" As you will see in later in this chapter, dental floss and a pair of pliers is not always ideal and there are several suture types for specific wounds. Secondary to this is ask, "do I have the right anaesthesia options to allow wound closure in a civilized manner?" Again, it is likely not worth trying to close a small forearm laceration on 4-year-old child who is flailing around like a madman when you approach them if you cannot at least provide local anaesthesia.

The final two questions are most important. "do I have the skill to close this wound?" and "what am I going to do if this wound gets infected in a few days post closure?" Your experience and training will dictate what type of suture does the wound need for closure and can you competently do it? Some of the common suture techniques which you may wish to learn/practice are ligatures, running stiches (continuous sutures), simple interrupted, interrupted vertical mattress, interrupted horizontal mattress, horizontal half-buried, deep – multilayer closures, purse-string sutures, the dog-ear technique, subcutaneous sutures and retention bolster sutures. Suturing is one of the few skills that is easy to practice over and over using basic materials such as a piece of cloth with a cut in it or more realistic training aids such as a pork hock.

The Art of Suturing

If you have decided to close a wound, first ensure that it has been properly cleaned, debrided and is free of infection. We cannot emphasize enough that closing a dirty wound will only lead to problems. Most wounds in the austere environment should be close by delayed primary closure due to the high likelihood of contamination.

Very basically, the technique of suturing involves using a needle to pass thread (suture material) through tissues to bring them together and hold them there to help the body heal the wound faster. In essence, you are making a smaller wound for the body to heal.

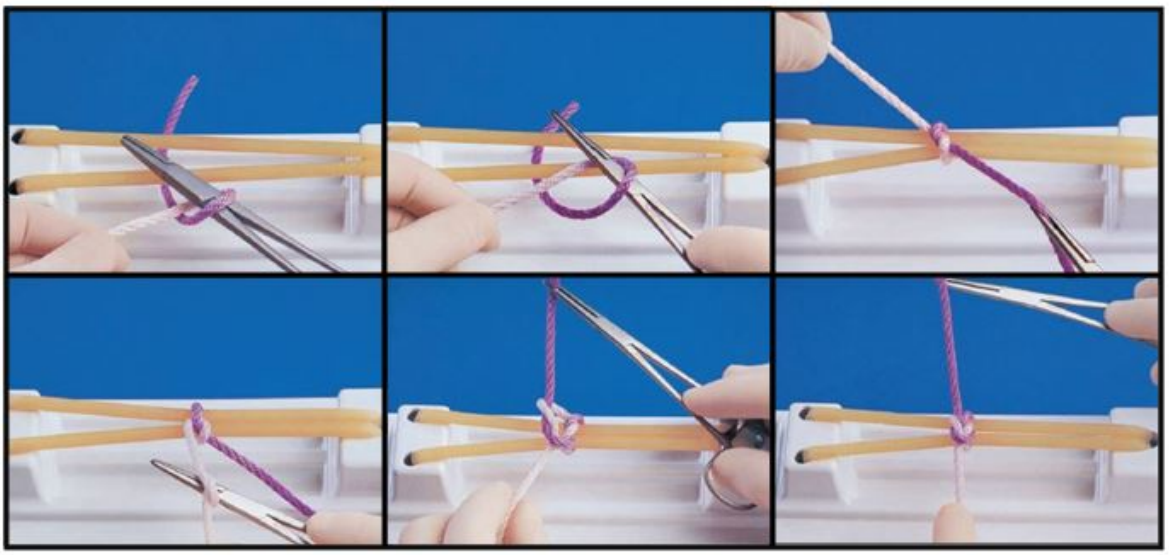
The goal in suturing is to match the appropriate tissue layers on each side of the wound as closely as possible. See the anatomy diagram above for details on the different tissue layers. Once the underlying layers are in good apposition, the skin may be closed.
We will briefly describe the technique for placing the most commonly used sutures and provide a diagram of some of the more complex sutures for your information.

The Square Knot

Simply threading suture through a tissue will do no good- you must have a secure knot to hold the tissue together. The square knot is the most commonly used knot in surgery and wound repair, and is made of two parallel half-knots ("throws"), placed on top of each other and tightened. You must have a good working knowledge of how to tie a square knot to effectively place sutures. You should practice tying this knot endlessly until you are very familiar with it. An improperly tied knot can come loose and all your work is in vain when the wound opens again.

A good way to practice is to use a board with a piece of fabric on it. The fabric can act as the skin. Another good method is to use animal tissue for a more realistic feel- a pork hock works well and skin on chicken is a second choice.

Instrument tie: Use a pair of needle holders to drive the needle into the skin, causing the needle to enter the skin at a 90-degree angle. Push the needle through the skin and up and out the other side. Pull the needle so there is about 2cm of suture material exiting the first hole. Grasp the needle in your left hand and the needle driver in the right hand. Place the needle holder against the long strand of suture and wrap the suture around the needle holder once. Rotate the needle holder and grab the short strand. The wrapped suture will slide off the needle holder and encircle the short strand. Gently pull your needle holder grasping the short strand toward you and the long strand away from you to tighten the knot. Be sure that the suture lies flat on the tissue surface. This is the first "half-throw". Release the short strand. Position the needle holder on the inside of the long strand of suture and wrap the strand around the needle holder once again. Grab the short suture strand with the needle holders and pull the strands opposite each other—this time the needle holders will be away from you. Snug the suture gently to prevent tightening the suture excessively. This second half-throw binds the first one to form a complete square knot.



Tying a square knot with an instrument. Ethicon Knot Tying Manual.

It is important to remember that when tying a square knot the half-throws should always be tied opposite each other so that they can bind against each other to create the knot. (The needle holder will

move away from you one time, then toward you the next time.) If they are tied the same way each time, it will create a Granny knot that transforms into a slipknot and will untie easily. One easy way to make sure the knot is tied correctly is to always place the needle holder in the center of the two strands of suture when placing the wrap on the instrument.

When tightening the knot you should always pull the two strands away from each other with equal tension on each strand. Keep your hands low and in line with the suture when tightening.

As a general rule, when placing a suture you should form two complete square knots which is composed of four "throws" or half-knots.

Surgeon's Knot

This knot is useful when closing skin that is under tension. It is a slight variation on the square knot- when making the first throw, simply make two wraps around the needle holder instead of one. This makes it less likely to slip while the second throw is being tied. The subsequent half-throws will be normal, with one wrap around the instrument. The surgeon's knot is weaker than a square knot, and should only be used if necessary. It should never be used to ligate vessels.

How Tight?

This is a question that every beginning surgeon struggles with. Tying the knot too tight will cause patient discomfort and can have a detrimental effect on wound healing. Alternatively, a knot that is tied too loosely will allow the wound edges to move away from each other and the wound will take longer to heal. With practice, you will gain a good feel for how much tension to place when tying the knot. The amount of tension to apply will also depend on the type of suture material used. To begin with, though, when tying the first half-throw, use enough tension to pull the wound edges together and allow the suture strands to lie on the surface of the tissue. Then tie the second half-throw and allow it to bind the first knot.

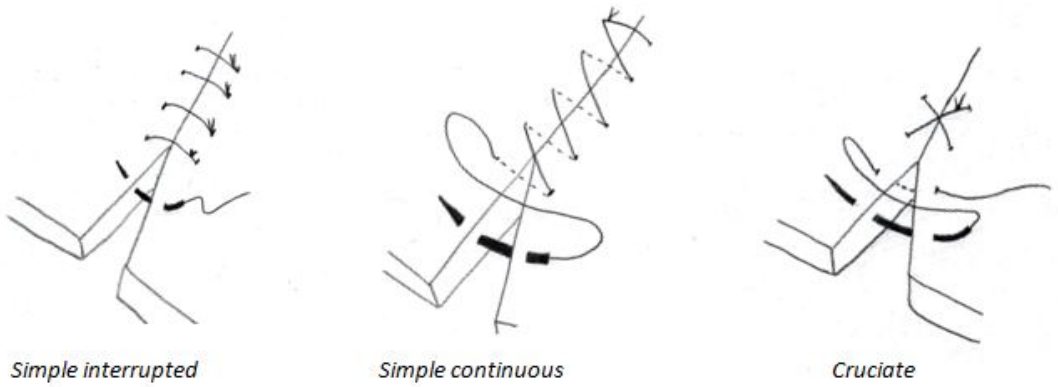
Suture Patterns:

Once you have mastered the square knot, you can begin placing sutures to close wounds. Briefly, a suture pattern can be interrupted or continuous. An interrupted suture line involves placing multiple individual sutures along an incision or wound line and tying a knot each time a suture is placed. A continuous pattern starts with tying a square knot at the beginning but using the long suture strand to continue as a running stitch until the end of the incision is reached and one knot is tied at the opposite end. A continuous pattern saves on time and suture but if one knot fails the entire suture line will come loose. They are generally reserved for use when closing abdominal incisions.

We will go over the three most commonly used suture patterns—a simple interrupted, simple continuous and a cruciate.

Simple interrupted
The needle is inserted into skin on one side of the incision or wound edge, passed through to the opposite side and tied. The knot is offset so that it does not rest on the incision. Both suture ends are cut short. Sutures should be placed 2-3mm away from the skin edge and approximately the same distance away from each other.

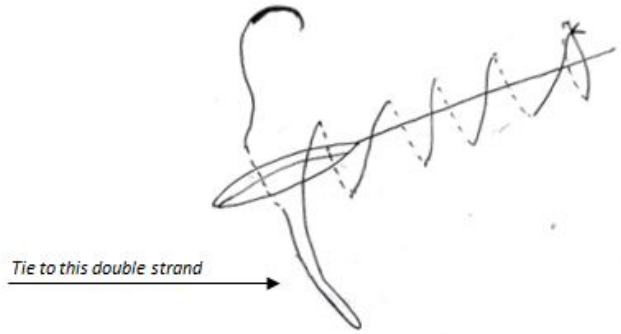
A simple interrupted suture can also be placed in the subcutaneous, fatty layer beneath the skin to approximate those tissues. Use the same technique described above, but begin with the needle deep in the tissue, exiting toward the surface but not in the skin layer. Next drive the needle from just below the skin layer to deeper into the tissue and tie the knot. This places the knot in the subcutaneous layer, away from the skin edge. This should bring the skin edges close together so that skin sutures can be placed with less tension. It also eliminates "dead space" underneath the skin so the wound heals faster and decreases the likelihood of infection.



Simple interrupted *Simple continuous* *Cruciate*

Simple continuous
Begin by placing a simple interrupted suture at one end of the wound but do not cut the long suture. Place the next suture just beyond the first one, perpendicular to the incision/wound. This creates a "running stitch" that should be continued until the end of the incision is reached. End a simple continuous suture by doubling back at the placement of the last stitch and leaving a length of suture there as a tying strand.

Cruciate
The cruciate stitch is stronger than a simple interrupted pattern and it resists wound edge eversion (puckering out). To place the stitch, insert the needle through the skin on one side of the wound, through deeper tissue and out the other side, just like you're placing a simple interrupted suture but do not tie a knot just yet. Leave a short strand of suture to tie to later. Drive the needle through the tissue again, just like you did before but about ¼" away from the first suture placement. Your needle should exit on the opposite side of the wound from the short strand. Tie a square knot using the short strand.

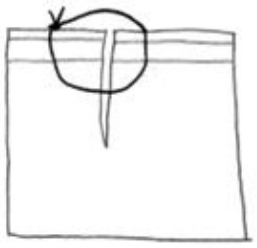


Ending a simple continuous pattern

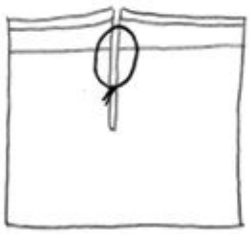
Closing the Wound:

As stated before, the wound should be very clean and free of bacterial contamination. If the wound is deep, it may be necessary to place sutures to bring the deeper tissues together before closing the skin above it. As mentioned before, this closes the open spaces below to prevent blood clot formation, decreases risk of infection and speeds wound healing.

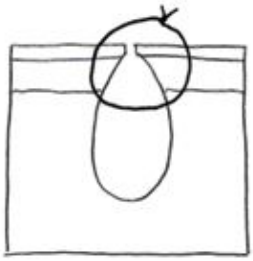
Once the deep tissues are brought together, you can close the skin. Use your sutures to bring the skin edges together so they are just touching. If you pull them too close together, they will evert and the edges will face upward. If the edges do not touch, it will allow for movement of the skin edges and wound healing will take longer. Remember that wound healing starts at the edges of the wound and moves inward, from one skin edge to the other. See diagram below for illustration of a properly closed wound.



Properly placed skin suture



Properly placed subcutaneous suture



Improper wound closure- note dead space below the skin

Suture Removal:

Most sutures can be removed as follows:

1. Most skin locations – 5 to 8 days.
2. Scalp – 6-7 days.

3. Tongue – 4 days.
4. Face and eyelids – 4 days.
5. Hand and fingers – 7 days.
6. Scrotum – 5 days.
7. Abdomen – transverse closure – 7 to 9 days.
8. Abdomen – vertical closure – 11 to 12 days.
9. Retention sutures – 10 to 14 days.
10. Skin on the back over the shoulders – 11 to 12 days.

Alternative Methods:

Staples: Staples can be used interchangeably with sutures for closing skin wounds. They are equally as effective and very easy to apply. Their main drawback is that from a cosmetic standpoint they are inferior to sutures – they may leave scars on removal. They are also more expensive. They come in several sizes ranging from 10 staples to 100 per pre-packages stapler. Staples are ideally removed with a staple remover. For scalp staples remove after 7 days. For wounds of the trunk and extremities remove after 7 to 14 days.

Glue: Glue is useful for small, superficial skin lacerations; lacerations only partial thickness or just into the subcutaneous layer. When used correctly it provides equivalent tensile strength to sutures. It should not be used around the eyes or mouth, and it is less effective in hairy areas. There are several brands of glue available, e.g. Histacryl and Dermabond. The issue of using Superglue is addressed in the Q&A section.

Tape: Skin closure tapes offer a good, low cost and low space/weight option for wound closure. They are also safer for the clinician to use when the patient has a blood-borne infectious disease due to the absence of a cutting needle on the suture. Correctly done (with the use of benzoin) they can be quite strong. They can also reinforce a sutured wound. Make sure the skin is dry and apply tape at 1/8" intervals.

Hair tying: Not perfect but has been successfully used for scalp lacerations. The wound should be cleaned, and hair along the edges of the wound formed into bundles, and then opposite bundles tied across the wound to bring the edges together. After 5-7 days, the hair can be cut from the wound edges.

Alternative suture material: Several materials can be substituted for commercial suture material in austere situation. Possible suture materials include – nylon fishing line and sewing nylon, dental floss (which is size 0 or 00), stainless steel wire, and colourfast cotton or linen thread, and in the absolute worst case, horsehair from the tail of a brown or black horse, boiled, then stored in a jar of alcohol. The latter should only be considered in an absolute worst-case scenario. If you only have improvised suture material available you should seriously consider if suturing is the right thing to do. Anything that is organic has a much greater chance of causing tissue irritation and infection. The best alternative is probably sterilized colourless nylon fishing line, as it is pretty much inert.

Alternative needles: Consider small sail makers', glove makers' or upholsters' needles. In theory, any sewing needle can be used – but curved ones are obviously easier to use. An ideal alternative to make a swaged needle is a hypodermic needle where the suture is passed through the needle and it needle is scored and broken off at the hub. The end is then crimped securing the suture to the needle. This can be done while sterile and conducting the procedure or in advance and then the material sterilized. It is also possible to manufacture suture needles from hypodermic needles. See the article by Remis titled, "Improvisation of Medical Equipment in Developing Countries" found in Tropical Doctor, 1983; 13:89.

If using a straight sewing needle heat you can heat it red hot and then bend it into a curve.

Making an improvised suture. Take an 18 ga needle scrape the plastic hub off with a knife. Insert fishing line and crimp in place. Using pliers bend the needle into a J shape and sew with hands holding the shaft of the J

Basic Dressings:

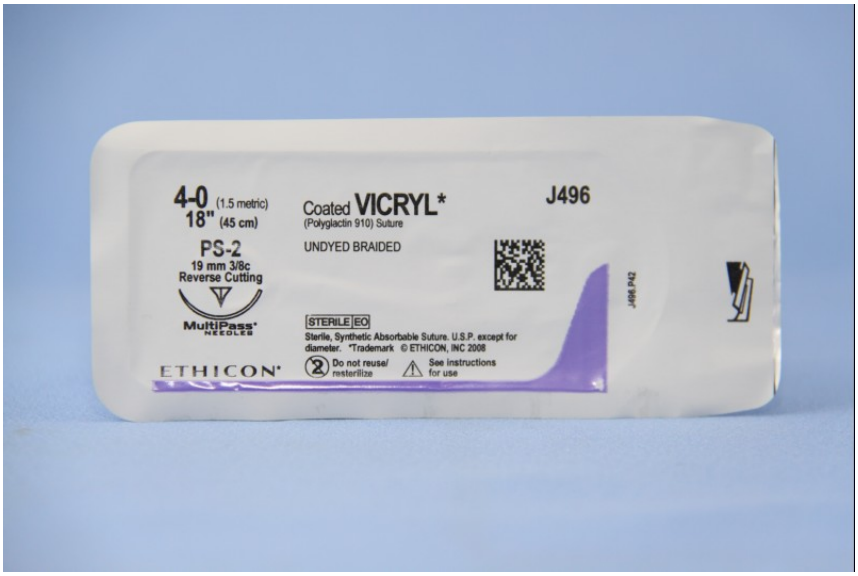
Following closing the wound, it should be covered and protected from water and dirt for 72 hrs. For most simple wounds this is all that is required – following this, they can be left uncovered and just kept clean.

The base dressing should be something non-adhesive if possible – that can be a commercial dressing or a simple piece of gauze coated with a thin layer of Vaseline. If the wound is small, it probably doesn't matter so much if it's non-adhesive or not and can be wetted prior to removal.

The initial dressing does not need to be complicated – a clean piece of cloth will be sufficient if nothing else is available. Its main role is to protect the wound and absorb any fluid that may leak from the wound. Basic austere dressings are discussed in more detail in the Primitive Medicine chapter.

Wound Closure Summary:

Our view is that the most versatile material is a synthetic non-absorbable suture like nylon (or an equivalent), in a variety of sizes with a 3/8 circle taper needle. An alternative or if you need an absorbable suture consider Vicryl or something similar. We would not recommend silk except in the absence of any alternatives. It is also worth considering disposable staplers if your finances stretch to that. Please remember, if you don't know what you're doing you may well make it worse.



8. When to Give Antibiotics

Good wound care is much more important than having the ability to treat a wound with antibiotics. Having access to antibiotics does not remove the need for good wound care.

You need to understand the difference between prophylactic use vs. treatment use. In this circumstance, we are talking about using the antibiotics to prevent infection (prophylaxis) rather than treat an established infection.

Certain wounds are more prone to infection than others. There is value to antibiotics in high-risk wounds. When we use antibiotics this way we refer to them as prophylactic antibiotic use. However, there is no substitute for good cleaning and debridement.

High-risk wounds include patients with:

- Significant amount crush damage
- Cat and human bites
- Possible joint penetration
- Diabetic/Immune suppression
- Wounds that were grossly contaminated
- Wounds to cartilage – ear, bridge of nose
- Limb edema

The International Committee of the Red Cross (ICRC) provide useful antibiotic guidelines for wounds – they are not necessarily perfect and are absent some of the sexy modern antibiotics – but they do provide safe and effective coverage:

High risk minor wounds - Penicillin V - PO 500 mg QID (4 times/day) x 5 days

Major wounds - Penicillin G - 5 million units IV QID x 48 hours then Pen V PO 500 mg QID until delayed primary closure. If you close with a split skin graft keep using Pen V x 5 days. If you go for a re-debridement, stop antibiotics unless you see infection. If you see infection then add metronidazole 500 mg IV TID and gentamycin 80 mg IV TID. These patients are the ones that worry me the most and get "the full meal deal".

Major wound - Cause = explosion - Penicillin G - 5 million units IV QID x 48 hours then Pen V PO 500 mg QID and metronidazole PO 500 mg TID until delayed primary closure

Major wound - delayed more than 72 hours in getting to you and/or compound fracture Penicillin G - 5 million units IV QID and metronidazole 500 mg IV TID (3 times/day) x 48 hours then Pen V PO 500 mg QID and metronidazole PO 500 mg TID until delayed primary closure

Chest wounds - Ampicillin 1g IV QID x 48 hours then amoxicillin PO 500 mg QID x 5 days.

Open head - Penicillin G - 5 million units IV QID and chloramphenicol 1g IV TID x 72 hours. If there is a suspected brain abscess add metronidazole 500 mg IV TID. Keep with IV meds or switch to PO for a total of 10 days.

Open eye - Penicillin G - 5 million units IV QID and chloramphenicol 1g IV TID x 48 hours. Keep with IV or switch to PO for a total of 10 days.

Face wounds - Ampicillin 1g IV QID and metronidazole 500 mg IV TID for 48 hours. Keep with IV or switch to PO (by mouth) for a total of 5 days.

Abdominal Wound - Solid organs only - Penicillin G - 5 million units IV QID x 5 days.

Abdominal Wound - Stomach/small intestine - Ampicillin 1g IV QID and metronidazole 500 mg IV TID x 5 days.

Abdominal Wound - Large intestine and below - Ampicillin 1g IV QID and metronidazole 500 mg IV TID and gentamycin 80 mg IV TID x 5 days.

d. Tetanus

Please ensure everyone's tetanus vaccinations are up to date. Tetanus is common in the environment and is a very real risk in an austere environment. The risk can be minimized by **cleaning any wound** well but in unvaccinated people the risk is still significant. It is a very horrible disease and you need to make sure everyone in your group is vaccinated up front and in the event of grid down situation everyone understands the importance basic early wound care of any, even trivial, wounds – make sure everyone in your group understands the need for every single wound to be thoroughly cleaned and disinfected if possible.

e. Hands

Hands are an absolute minefield of potential problems. There are plenty of complicated layers of tendons and nerves. An apparent simple injury can cause disabling loss of function. You need to apply the basic principles well and sanity check your competence and decision making to close a wound. Ask the simple question: will you make the injury worse or better? If the answer is "worse" the patient living with the traumatic loss of function may have less of an impact on their function than an unskilled repair which may do further damage.

F. Beyond Simple Wound Dressings

Basic Wound Management:

When you allow a wound to be closed by delayed primary closure, how do you manage the dressing of the wound until closure? In the case of healing by secondary intention how do you dress the wound? What a sutured, but weepy wound?

1. Use dry fluffed-up sterile gauze layers or absorbent cotton/wool layers. Essentially you are putting a bulky fluffy layer next to the wound to absorb exudate. Do not pack tightly into the wound. The exception is when there is exposed tendons or joint capsules, these must have saline soaked gauze over them.

2. Hold the dressing in place with an elastic bandage, tape, or something stretchy like vet-wrap (or even homemade bandages from cloth). Exactly what you use depends on size and location. You are just trying to keep the bulky dressing in place. Bandage over the gauze/absorbent layer in a non-circumferential ("figure 8" manner) in case the limb swells and nobody is around on in the clinic to notice. You do not want to make a tourniquet with your dressings.

3. The problem with this technique is that dressing changes, when warranted due to exudate (and not routinely) then need to be done under sedation or anesthesia due to the pain of changing them (the gauze and cotton will have stuck to the wound in parts where the exudate does not keep it afloat). This can be avoided by impregnating the gauze that is right next to the wound with white petroleum jelly to prevent it from sticking. If you do this, you can change dressings, with a minimal pain control. The problem with Vaseline gauze is that is does not absorb exudate or allow it to pass through to the bulky dressing thereby sometimes creating a plug.

4. Dressings should not be removed "just to look at the wound". In potentially less than clean medical clinics in an austere environment this just opens the wound up to infection.

Open the dressing up when it is time to do delayed primary closure on day 2-5 (normally 4-5 days) in the surgical area. If the casualty is eating and comfortable wound healing is occurring. If the dressing becomes soaked in exudate over-dress with more bulky gauze/absorbent cotton, or take down the bandage and wet bulky gauze, wet and replace without disturbing the gauze compress that is in direct contact with the wound.

The state of the dressing is not an indication of the state of the wound. This is much different than in America where we do doctor-ordered dressing changes every 8-12 hours or daily. You need to be comfortable with the different process. You will smell a sour odor after several days. This is the "good-bad smell" of ammonia products from the breakdown of serum proteins. It should not be confused with the infected wound that has that characteristic offensive odor also known as the “bad-bad smell”.

5. For most wounds, there is no value in impregnating the dressing with iodine, chlorohexidne, sodium hypochlorite, etc. In fact, it likely does more harm than good.

6. If a wound continues to bleed, you need to take the dressing off and conduct an immediate re-exploration. If you have vascular changes indicating ischemia (loss of bloodflow), the same. If you have obvious signs and symptoms of infection: fever, toxicity, excessive pain and tenderness, warmth, redness or shiny surface in dark-skinned people, edema and induration, or a moist wound dressing with an offensive smell, you need to take down the dressing and surgically re-explore the wound (which may often requires additional surgical excision). This is not a bedside nursing problem and the infection will not be solved with simple nursing dressing changes.

7. The use of a negative pressure dressings in austere medicine is an option and is discussed in detail below. It is now being used somewhat routinely in places like the Ukraine and Iraq/Syria. The negative

pressure helps to keep the dressing dry by removing the exudate. This decreases the frequency of dressing changes thereby freeing up limited nursing staff/OR time and supplies.

A basic wound management kit should be composed of lots of gauze that can fluff up, some ace bandages, tape, a little bottle of tincture of benzoin and Vet-wrap. A kit like this is truly inexpensive.

Retention Sutures:

Large wounds that are gaping open may heal faster if tension is off the wound but the wound margins are pulled together, but not closed to prevent trapping of infection deep in the wound base. You take large bites with a big suture and partially pull the wound margins together. Cut sections of a Foley catheter or IV tubing is used at the surface to pad the suture from pressing too tightly on the skin i.e. the suture passes through the tubing.

By increasing tension, granulation tissue at the base of the wound can be approximated and heal together. Then the suture can be progressively tightened to bring the open wound together. Think about this in a large wide-open wound only.

Continuous Irrigation of Infected Wounds:

When antibiotics are not available or are not winning, try continuous irrigation. It is generally used for wounds or infections of incarcerated spaces like tendon sheaths and joints and contaminated bone.

An intravenous catheter can be placed in a tendon sheath and a drain or another catheter placed distally. A continuous drip of normal saline can be run for 2-3 days, flushing out the space and reducing bacterial damage the local structures. Joints can be flushed in a similar fashion short of an open wash out (which is preferred if you have a surgeon) if that's not available.

Exposed bone is prone to osteomyelitis and should be washed/irrigated extensively and covered by well-vascularized tissue as soon as possible. Bone that cannot be covered may need amputation or debridement. Bone that has been exposed and presents late may respond to a trial of coverage with irrigation placed along the bone. This is a last-ditch attempt to save a limb risking sepsis and further infection.

However in a resource poor environment where amputation likely leads to inevitable death from being unable to work each day it is an option.

Suction/Vacuum (Negative Pressure) Dressings:

Negative pressure dressings involve packing the wound with absorbent foam and then placing an airtight dressing over the wound.

Animal and human studies have demonstrated that this technique:

- ❖ Optimizes blood flow in the wound bed
- ❖ Decreases local tissue swelling
- ❖ Removes excessive fluid that can slow cell growth and proliferation in the wound bed
- ❖ Increases granulation (healing) tissue formation
- ❖ Decreases numbers of bacteria.

Wounds which are slow to heal where there has been loss skin or where a split skin graft has been applied are suitable for negative pressure dressings.

It can be a two-stage process:

- Negative pressure can be applied to the wound to encourage granulation tissue to develop prior to a skin graft being placed.
- Once the graft is applied negative pressure can be applied to encourage the graft to take.

The before applying a negative pressure, is ensuring that the wound is thoroughly debrided and cleaned.

To apply a negative dressing the following are required:

- A source for creating the negative pressure (an aquarium pump running or plumbed in reverse produces a small but consistent suction) – the pump needs to generate approximately 125 mmHg (although if the high pressure is intolerable – less pressure (50-60 mmHg) is ok) in negative pressure and plastic tubing to connect the pump to the wound, which can be sterilized.
- A foam dressing to pack the wound – it is unlikely to be a dedicated foam dressing will be available so it is appropriate to use the dense foam typically used to contoured equipment boxes
- An airtight dressing which enable the vacuum to be created – while a dedicated dressing is ideal – a square of plastic bag – twice the size of the area being covered can be used and firmly bandaged to the area – this will usual create an air tight central area or a defibrillator pad or a commercial chest seal.
- A collection container to collected the fluid sucked from the wound

The wound should be loosely packed with the foam, and the tip of the suction tubing placed across the wound and the wound sealed with only the suction tubing sticking out which should be connected to the suction source. It may take several weeks to encourage wound healing or the formation of extensive granulation tissue to make it suitable for a split skin graft.

Honey Dressings:

Honey is discussed in detail in the *Clinical FAQ* chapter.

F. Wound Infections:

Some wounds will get infected, it is a fact of life. The Incidence in a wound closed in an Emergency Department-closed wound is 3-4% vs. an operating theatre-closed wound of 1%. A wound closed in an austere environment will be some way north of the ED infection rate, but hopefully only a few more percent.

So why do wounds get infected? They get infected because for some reason they are contaminated.

- foreign bodies
- bacterial exposure
- There is dead tissue in the wound.
- The water used to irrigate and clean the wound is contaminated – this is probably one of the more common causes of wound infection in the Second and Third World.

The goal is to minimize the risk of an infection developing. This is done by copious irrigation/ cleaning, through debridement and not closing dirty wounds or wounds > 8 hours old

There are some signs consistently associated with infection (although not all may be present):

- Local redness around the wound.
- Purulent discharge (some discharge is normal)
- Increasing pain
- Systemic symptoms like fevers, chills, shakes, headaches, nausea or vomiting.

If a wound looks infected, take down any dressing and thoroughly wash the wound with clean water. Consider removing any sutures that are still in the wound, sutures can act as an infective focus and while still in an infected wound can make it almost impossible to get rid of any infections. Removing the sutures allows the wound to drain. Wash out the wound and debride any obviously dead tissue.

This is often sufficient, but if there is evidence of cellulitis or the patient is systemically unwell, consider an antibiotic (if one is available) like Flucloxacillin or Augmentin or Cotrimoxazole – all of which have good coverage over most bacteria commonly causing wound infection.

i. Suture and Needles:

Surgeons in ancient India painstakingly separated the mouths of ants and beetles from their body to use their jaws as sutures. Fortunately, science has come a long way and there are many choices of needle & suture available.

An area which is poorly covered and where there is a great deal of inaccurate information is regarding suture materials and needles. In a pinch your fishing line and a normal sewing needle may be okay, but they are far from ideal. If you are stocking up you need to understand what to buy and why.

The manufacturers of suture material have a wealth of material available on their websites and this is a good place to start reading. Ethicon for example has an excellent website to learn from.

If you are going to be doing a lot of suturing, suture material is less expensive (like 20,000%) if bought on the roll without a needle then in pre-packaged with the needle attached. For the novice clinician, the pre-packaged suture with needle is much easier to use however and saves fabrication.

Basics:

Sutures have the following characteristics:

1. Tensile strength - how long a suture can be relied on to hold tissues together.
2. Absorption - how long it takes for the suture material to be absorbed by the body.
3. Type – plain, chromic, braided or monofilament. The strand description.
4. Tissue reaction – how much localized reaction the suture causes in tissue.

5. Material – natural or synthetic.
6. Size - the diameter of the suture.

Most selection starts with looking at if you want absorption and then the other characteristics which you require/desire:

Absorbable → natural or synthetic **OR**
Non-absorbable → natural or synthetic

AND

Monofilaments – suture made of a single strand **OR**
Braided – suture made of several filaments twisted together

- **Natural absorbable:**

Surgical Gut: Collagen material derived from the submucosal layer of sheep or the serosal layer of cattle intestines. Almost pure collagen. Absorbed by enzyme action. It is easier to use if slightly moistened with sterile saline (but not soaked). Will deteriorate if stored in hot areas. Two types:

Plain gut: Tensile strength for 5-7 days, absorption within 42 days. Used primarily for ligating blood vessels and closing the fat layer. Moderate tissue reactions.

Chromic gut: Gut treated with chromium salts. Strength for 7-10 days and absorption within 70 days. Versatile material commonly used for closing bowel, uterus, and episiotomy/tear repairs; okay for skin but not first choice. Moderate tissue reactions.

- **Natural non-absorbable**:

Surgical Silk: Spun by the silk worm. Braided. Tensile strength for up to one year. Causes significant soft tissue reaction. Hold knots very well. No longer indicated for routine use. Much better products available. If used, it should be used dry. Although classified as non-absorbable several studies have shown it losses tensile strength in one year and cannot be found in tissue after two years.

Stainless steel: commonly used either as staples for the skin, for wiring the sternum following cardiac surgery, orthopaedic work, or for tendon repairs. Minimal tissue reaction occurs. Use care not to bend or kink. Surgical stainless steel suture material is sometimes sized using the Brown & Sharpe (American Wire Gauge) system (versus USP) where 40 is the smallest and 18 is the largest diameter.

- **Synthetic absorbable:**

Most are synthetic protein polymers. Exact names vary with which company has produced them but each company has equivalent products.

Poliglecaprone (MONOCRYL): Monofilament. Comes in two types: dyed (violet in colour) and non-dyed. Dyed has 60-70 % strength is retained at 1 week and 30-40% retained at 2 weeks with all strength gone by 4 weeks. Undyed has 50-60 % strength is retained at 1 week and 20-30% retained at 2 weeks with all strength gone by 3 weeks. Absorption for all MONOCRYL sutures is complete by 91-119 days. Inert with

no issue reaction. Useful for internal sutures and subcutaneous use. There are versions of this suture that contain an antibacterial coating. These have slightly different characteristics and the cost of procurement does not outweigh the benefit in survival medicine situations.

Polyglactin 910 (VICRYL, Polysorb): Braided or monofilament. Strength for 6-0 and larger sutures is retained at 75% strength for two weeks, 50% at 3 weeks and 25% at 4 weeks.

Absorption is complete by 70 days. Very versatile suture, useful for most things: Skin, internal tissues, episiotomy, and vaginal tear repairs. It should not be used in ligation. There are versions of this suture that contain an antibacterial coating. These have slightly different characteristics and the cost of procurement does not outweigh the benefit in survival medicine situations.

Polydioxanone (PDS II). Monofilament. Provides extended wound support of up to 6 weeks. 70 % strength is retained at 2 weeks, 50% at 4 weeks and 25% at 6 weeks. Absorption starts at 90 days and is complete at six months. Useful for internal sutures and subcutaneous use. Slightly reactive in tissue.

- **Synthetic non-absorbable**:

Nylon (ETHILON). Monofilament; high tensile strength material; low tissue reaction. Ideal for skin closure. It degrades in the body at a rate of 15-20% per year. Nylon has as “memory” from the package. This is best removed by drawing between the gloved fingers before starting to suture. It is easier to work with if damp or wet.

Polypropylene (PROLENE): Monofilament; high tensile strength material; biologically inert and therefore a low tissue reaction. Easy to remove as they do not adhere well to tissue. Also, good for skin closure.

Other types of synthetic non-absorbable sutures you may encounter are a braided nylon suture (NUROLON) and polyester fibre sutures (MERSILENE and EXCEL). These sutures are not commonly useful in the survival medicine practice.

Braunamid: A synthetic, braided suture that is used extensively in veterinary medicine for skin closure. It is composed of many fine twisted strands covered by a smooth polyamide cover. Because of its polyfil construction, Braunamid thread is considerably more flexible than the monofil sutures, has low memory and is easily handled. Knot-pull tensile strength substantially exceeds USP requirements. Knot-holding ability is excellent because of its inner polyfilament structure.

Thread Size:

Strength increases with the increasing size of the thread. Tissues under more stress and tension require a stronger thread. One of the general concepts of suturing is that you should use the smallest size appropriate to minimize the "amount" of foreign material you are introducing to the wound.

The thread size is the diameter of the suture. It can be given in metric measure or United States Pharmacopeia (USP) size. USP descriptions are most often used and conversion between USP size and metric measures is complicated by the requirement to account for the type of material in the suture (natural collagen, synthetic absorbable, non-absorbable or wire) when doing the conversion.

USP sizing uses the number of "zeros" to determine size. The more zeros the smaller the suture. For example, sutures can be expressed as 5-0, or 2-0 or 4-0. This really is 00000 (five zeros), 00 (two zeros) and 0000 (four zeros) respectively. USP sizes go from 11-0 (smallest) to 6 (largest), where it is uncommon to see suture materials smaller then 7-0 or larger then 1 in most clinical locations. Note that 1-0 is just expressed as 0 and that vernacular is regional, often with the zero being replaced with "oh" in common usage, for instance, four-"oh" silk really meaning 4-0 silk.

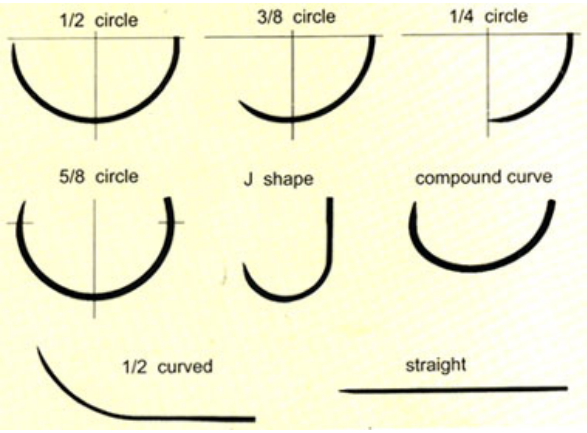
Common sized based usage includes:

Location	**Thread Size - Skin**	**Thread Size - Deep**
Scalp	4-0 or 5-0	4-0
Face and Forehead	6-0	5-0
Eyelid	6-0 or 7-0	--
Eyebrow	5-0 or 6-0	5-0
Nose, Ears and Lips	6-0	5-0
Trunk	3-0 to 5-0	3-0
Extremities	4-0 or 5-0	4-0
Hand	5-0	5-0
Foot	3-0 or 4-0	4-0
Penis	5-0	--
Vagina	--	4-0
Scrotum	--	5-0
Ligature of vessels	--	3-0 to 1

Needles:

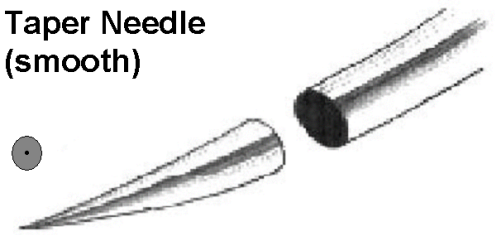
Two basic shapes - Curved
- Straight

Most common: 3/8 or 1/2 circle curved needle. The 1/2 circle is more useful if you are working in a confined wound space, such as deep in the wound. The 3/8 circle is most common for skin closure.

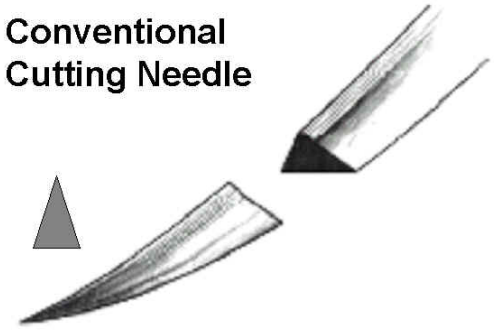


Three main types of needles:

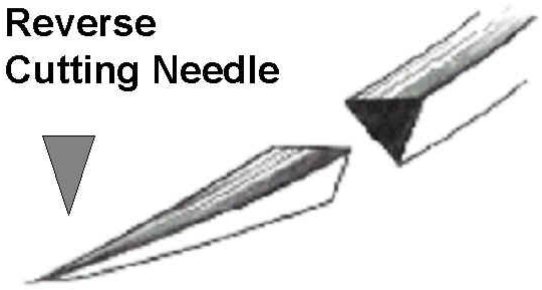
- **Taper:** Sharp point which tappers down to a circular needle. Most versatile general-purpose needle.



- **Cutting:** Triangular-shaped needle point with a cutting edge on the inside curvature of the needle. This type works well on tough tissues. Not good for the amateur.



- **Reverse cutting:** Triangular-shaped needle with the cutting edge on the outside curvature of the needle. Again, good on tougher tissues such as fascia, ligaments, oral mucosa, tough skin and tendon sheath. It is easier to use than a cutting needle.



Do not pull on the needle with great force as it possible to pull the needle off the suture.

References:

Practical Plastic Surgery for Non-Surgeons by Nadine B Semers MD isbn 978-0-595-46189-9

Chapter 12 Family Planning, Pregnancy, and Childbirth

Even though women have been having children since the beginning of time, having babies is a relatively high risk activity. Women can die because of complications during and after pregnancy. Poverty, malnutrition and an immature reproductive tract put younger women at more at risk for pregnancy complications, especially in developing countries. A woman's chance of dying in childbirth also increases the more pregnancies she has.

Fortunately, science has made great strides in preventing maternal deaths. Most women die because of severe bleeding, infections, high blood pressure or complications from delivery, and most deaths now occur in developing countries. With the presence of a trained midwife or obstetrician, though, the chances of a woman surviving childbirth are much greater. In the developed world, modern obstetrics have decreased the maternal death rate due to pregnancy and birth related problems to about 1: 10,000, while most developing countries still experience a much higher rate of almost 1:400.

It is also much riskier to give birth in fragile or humanitarian settings, where health care is less accessible. Childbirth is dangerous for the baby, too. Roughly 45% of child deaths occur within the first 28 days of life, the neonatal period.

There has been a recent shift in the developed world to return to "natural childbirth". Many believe that, whether for sake of convenience or safety, modern obstetrics intervene too soon in the delivery process. Thus, the return to at-home childbirth is not entirely wrong, but should be accompanied by a midwife who has experience assisting many women with childbirth. This person should be trained in many areas, from women's nutrition during pregnancy, the stages of labour/delivery, cleanliness at delivery, to neonatal care after birth. In a state of economic collapse, access to health care for expecting women will be hard to find and the role of a midwife will once again become very important.

The perception of low-risk childbirth has only come about through the development of expert midwifery and obstetric care in the last 50 years. For most women childbirth will be very straight forward, but don't underestimate the risk. In an austere situation, there may be good reasons to avoid childbirth, particularly for women who have already had a caesarean section or a complicated pregnancy before the collapse. In addition, a new baby is literally another mouth to feed and a breastfeeding mother has a higher nutrient requirement as well. Over time, the child will grow and need an increasing proportion of the food resource.

Contraception:

Contraception is important; preventing pregnancy may be desirable for many reasons as discussed above – maternal risk or lack of resources for the child. As part of your preparations you should consider options for birth control. Both condoms and the oral contraceptive pill store relatively well in a cool dry environment. Like other drugs, though, their effectiveness will decline beyond their expiration dates but how much and over what time period isn't known.

Natural family planning can be used to predict when a woman will be fertile, and couples can avoid sexual intercourse during this time. A woman is only fertile for about 100-120 hours per month and determining this period can be estimated with high probability. As discussed in *A Book for Midwives*, we will briefly cover two methods of natural family planning here. Best results are had when both methods are used together.

The Mucus Method: A woman should check the mucus from her vagina every day. When she is fertile, the mucus will be stretchy and slimy, like raw egg white. Do not have sex on these days. On days she is not fertile, the mucus will be dry and sticky. It is probably okay to have intercourse 2 days after the first dry day. After tracking these changes for some time, a woman should be able to easily recognize them.

Counting Days Method: This method can be used by women who cycle regularly every 26-32 days. Day one of the cycle is when her monthly bleeding starts. A woman should not have sexual intercourse from the 8th day of her cycle through the 19th day of her cycle. If she does have sex during this time, she should use another method of family planning to prevent pregnancy.

When used consistently, natural family planning is a reasonably reliable option. More information can be found at http://www.bygpub.com/natural/natural-family-planning.htm.

Abstinence is also an option which can also be considered. However, this hasn't proved overly successful in the past so there is no reason to think it would in a stressful future environment!

You should stick with the method you know – a time of crisis is no time to be trying out natural family planning for the first time when you have used condoms for the last 10 years. The best time to start is now, and plan ahead, but be aware of the alternatives. Information on other family planning options and emergency contraceptives can be found in the book *A Book for Midwives*.

"Do it yourself condoms": Condoms can be made from sheep's intestines. While you are manufacturing your suture material you can also whip up a few condoms. The basic process is straightforward. They can be and have been manufactured from the caecum of a sheep. The process is simple; the gut is soaked, turned inside out, macerated in an alkaline solution, scraped, exposed to sulphur vapor, washed, blown up, dried, cut to length, and given a ribbon tie for the base. It was necessary to soak them to render them supple enough to put on and they weren't disposable. The alternative method from early last century was to dip a wooden mold into melted rubber, let it dry and set, and then roll it off.

Childbirth:

This is not the forum to discuss the full mechanics of pregnancy, labour, or delivery. There are many excellent books (see references) on midwifery, which covers this in detail.

Your medical kit should have the basic components of an emergency delivery kit:

1. Your brain and your clean hands. These are the 2 most important things. You must keep your wits about you and be ready to help if Mother Nature is having problems. The trick is in knowing just when to leave everything alone and when to help. Cleanliness is CRITICAL. Post-delivery deaths from all causes

dropped 95%+ when delivery attendants, midwives, and physicians started washing their hands with soap.

2. Something to suction the baby's nose and mouth out with. Like a bulb syringe, turkey baster, etc. You can also finger sweep the mouth or in a pinch put your mouth over the baby's mouth and nose and suck gently.

3. Clean cord, cloth strips, or cord clamps to tie off the cord, and a sterile (if possible – otherwise immaculately clean) instrument/blade/scissors to cut the cord. This is important. Neonatal tetanus from cord cutting with dirty instruments accounts for 3/4ths of all tetanus deaths worldwide. It's OK to leave the cord attached to and with placenta at an even level with the baby for a while until you can get a clean instrument if needed.

4. Gloves: Sterile are better but at least use clean unused exam gloves. If no gloves are available then ensure your hands are scrupulously clean.

5. Clean towels and pads, and blankets to wrap baby in, etc.

Pre-packaged sterile delivery kits are available for about $10.00 USD with all of above in them.

Do you know why they always run around boiling water & ripping up sheets in old movies featuring a delivery? The hot water is, of course, wanted for washing hands and instruments, but also hot moist packs can be placed against mom's perineum to help relax the muscles and tissue, and allow them to stretch easier with less chance of tearing. This is a technique which is completely lost in modern obstetrics that works well. Also ensure that you have a hand basin immediately available for frequent hand washing.

Most deliveries are very straightforward. This is why the human race has survived for so long. More than 90% of all healthy women will give birth with no problems at all. This still leaves a significant number of women who may run into trouble. Problems are more likely to arise with the first baby, with older mothers, mothers with previous delivery complications and/or multiple previous deliveries.

Normal Delivery Process:

The following is a brief overview of the way a delivery typically progresses. If you anticipate any pregnancies among your group, it would be a wise decision to obtain the referenced midwife book. Even if you don't anticipate any pregnancies, having the book is cheap insurance against the unplanned pregnancy.

There are 3 stages of labor. The first stage is the initiation of contractions and ends with the cervix being completely opened (or dilated). The second stage of labor is when the baby is born, and the third is the passing of the placenta.

Stage one is usually the longest part of a woman's labor, and can last for 20 hours or more. The time is typically shorter for women who have had babies before. At the beginning of stage one, early labor, the mother will begin to feel light contractions which last around 30-45 seconds, with 5-30 minutes in

between. During this time, the mother should continue about her daily work and rest up for the coming delivery. The contractions will become stronger and more frequent as time goes, which is termed active labor. The purpose of the contractions is to push the baby from high up in the uterus to down to the vagina so she can be born. Early labor usually lasts 4-8 hours. At some point during this stage the amniotic sac (water) will break and some or all its fluid will come out. This usually happens toward the beginning of stage one.

The last part of stage one can be particularly painful for the mother, and is termed active labor. Stronger contractions come close together and last 60-90 seconds. A mother may begin to feel the urge to push, but she should refrain until the cervix is completely dilated. To confirm a dilated cervix, a sterile/very clean vaginal exam may be performed.

Estimation of dilation can be difficult – but the presence or absence of the cervix is usually discernable to a lay practitioner. The cervix feels like a rim of tissue in the vagina. At the start of labour it may feel like a 3-4cm lump in top of the vagina with a small dimple in the middle. As active labor progresses the cervix thins and opens – so it goes from like a lump to a slightly raised plate shaped area 10-12cm across with a small hole in the middle. As labour progresses and the cervix dilates – the hole in the center gets bigger and bigger, until all you can feel is babies head (which will be obvious) and no cervix – fully dilated.

In an austere environment where a sterile exam is not always possible, you may have to look for other signs to mark the onset of stage two—an uncontrollable urge to push as the baby moves into the birth canal, less frequent contractions but still very strong, a change in the mother's mood (she may become sleepier or more focused), bulging of the mother's genitals, and the mother may feel the baby's head descending.

When the cervix is fully dilated (10cm), the second stage begins.

Stage two marks the delivery of the baby. It may last a few minutes, or up to several hours. At the beginning of this stage, the contractions may come a little farther apart and the mother may take that time to rest. The mother can try several different positions to see which is the most comfortable for her—squatting, lying on her side, half sitting, standing or on her hands and knees. Encourage her to push with each contraction. You will see the baby's head crown as the widest part of her head emerges. The first glimpse of her baby can be a comforting sight for the mother, a sure sign that the end of her painful delivery is in sight. Gradually the baby's forehead is visible and the top of the face will be visible, then her body will rotate as she makes her descent through the pelvis. After the head comes out, you should use a gloved finger to check around her neck for the umbilical cord. If it is wrapped around her neck, slip it over her head. If you absolutely must cut the cord before the baby is born, encourage the mother to deliver the baby quickly because the baby will no longer have her mother's blood supply. When the baby's nose and mouth emerge, check them for mucous and fluid. If present, gently wipe or suction it out even before she is born. Once the head crowns, delivery should commence quickly. You do not need to push or pull of the baby's head as it delivers. All you need to do is to gently support it with light pressure to prevent a very rapid delivery causing damage to mum's perineum.

After the baby is born, dry her off and lay her on the mother's belly to keep her warm. The third stage of delivery is the delivery of the placenta. With a few more uterine contractions, the placenta will separate from the wall of the uterus and pass out. This usually only takes five or ten minutes after the baby is born. In an austere setting, it is probably best to leave the umbilical cord intact until the placenta is passed. You will see the cord change from blue and pulsing to white and shriveled as the mother's blood

supply is lost when the placenta detaches. Now, using sterile instruments, clamp the umbilical cord in two places. Use sterile string to tie a square knot on the baby's side, then cut the cord between the clamps.

Delivery Complications:

There are several areas where problems arise; the following is just an overview of the more common:

Obstructed labour/slow progress: Midwives are experts at encouraging slowly progressing labour without medical interventions. If the baby is not born after 1-2 hours of strong contractions and good pushing, try a natural method to help. Encourage the mother to stand or walk around—gravity causes the baby's head to push on the cervix and stimulate contractions. Having the nipple suckled or stimulated for 10 minutes causes the release of the hormone oxytocin, which stimulates uterine contractions. Acupressure is a type of massage that can be used to encourage labor. Try rubbing the mother's hand, between the thumb and finger, or on a spot on the inside of the leg, about 4 fingers above the ankle bone. Move your thumb over that spot in small circles. If labor does not progress, make every effort to take the mother to a medical facility.

It is important to know that a first-time mother may take a full 2 hours and sometimes more to deliver the baby. If the baby is continuing to move downward and has a normal heartbeat, and the mother is still strong, the birth is normal and healthy.

In a medical hospital, if labor fails to progress, it is augmented with oxytocin or a caesarean section. When there is no prospect of vaginal delivery due to obstructed labour or malpresentation then there are two options for delivery: forceps/suction delivery or caesarean section. Both require significant skill and equipment.

The reality for most is that in a primitive situation this will be beyond the midwife; if the baby is unable to be delivered, the mother will die.

Breech presentations: This is where the baby is coming bottom first rather than normal headfirst. The head is the biggest bit of a baby. During normal birth the head moulds itself and slowly stretches the birth canal to a size it can pass through. When the bottom comes first this slow stretching does not occur. Consequently, there is a risk of the head becoming stuck or the baby being asphyxiated before the head can be delivered. There are several measures, which are well described in the references aimed at delivering breech babies. If the baby dies during the birth process they can usually still be delivered without endangering the mother's health.

Infection: One of the biggest killers relating to childbirth prior to the last century was infection. It is not uncommon today, particularly with more complicated deliveries but fortunately it is very responsive to antibiotics.

If you must assist the mother in any way, you need to pay very close attention to antisepsis. Wash your hands often and wear gloves, sterile if possible. Clean the area where births happen

and wash bedding after every use. Wash and sterilize instruments before use and throw away waste products safely to prevent other people from getting sick from the germs on them.

Always do a thorough three-minute hand wash before touching the mother's vagina or helping deliver a baby: take off any jewelry and use soap and clean water to scrub all the way up to your elbows. Scrub between your fingers and under your fingernails using a brush. Keep scrubbing for 3 minutes (use a clock or a timer!), then rinse with clean running water. Dry your hands in the air instead of using a towel and do not touch anything until your hands are dry.

Cleanliness cannot be overemphasized here! It is very important to help prevent the mother from getting an infection after delivering.

Post-Partum Hemorrhage: This can occur early (within 24 hours) or late. Late hemorrhage is almost always due to infection. Early bleeding is caused by failure of the uterine muscles to contract and close off the connection site of the placenta; lacerations of the cervix especially the anterior lip, vagina, vulva; retained fragments or pieces of placenta; abnormal attachment of the placenta during the pregnancy; rupture of the uterus; inversion/prolapse of the uterus; bleeding disorders and blood clotting problems, either as a result of inheritance or pre-eclampsia/eclampsia. The most common cause is failure of the uterine muscles to clamp down (atony), lacerations, especially of the cervix, and retained placental fragments.

The average blood loss after an uncomplicated vaginal delivery is often around 500-600ml, which is by textbook definition, classified as a hemorrhage. Also note that vaginal blood loss is consistently **UNDERESTIMATED by 50-100%** so that if you think you lost 500 ml it's probably more. Blood loss after delivery is normal in this amount, and if mom was healthy and not severely anaemic before delivery is not a problem. Also, it is normal for bleeding to continue in small amounts after the delivery, and bloody mucus (lochia) can continue for some time. But continued bright red bleeding like a heavy period or greater amounts, increasing size of the uterus (womb), etc. is not normal. Around the world, very heavy bleeding (post-partum haemorrhage) is one of the most common causes of death for women.

Treat for shock just as you would any hemorrhagic condition: lay flat, keep warm, IV fluids if available, monitor vitals, etc. To locate the source of bleeding, begin by palpating the top of the uterus by placing your hand on the mother's belly. If the uterus is firm and small, it is well contracted and probably not the source of bleeding. If it is soft and small it may not be well contracted and it may fill up with blood and enlarge. Use gloves and examine the perineum for tears. Check the outer vulva and rectum, inside the vagina and the anterior cervical lip (be careful not to contaminate the uterus or vagina with any fecal material from the rectum!). Bleeding may be coming from a visible source such as a vaginal tear, or simply coming from out of the cervix with no visible tear. In this case, the bleeding is coming from within the uterus.

If the cause of bleeding is an obvious external or vaginal laceration, manage appropriately with a repair. Consult the reference sections for more details on the basics of obstetric repairs.

Most heavy bleeding occurs simply because the uterus will not contract or a piece of placenta is left behind. Nipple stimulation either through breastfeeding or direct stimulation releases the hormone oxytocin which stimulates contractions and is the first treatment choice. Gentle rubbing of the uterus also stimulates contractions and should be tried. Have the mother rub her

uterus every couple minutes until it becomes firm and small, and remains that way. If the uterus is large and soft, firm pressure on the uterus may expel accumulated blood clots and assist contraction. Also encourage or assist the mother to empty her bladder as this helps the lower part of the uterus to contract.

The second priority is to ensure the placenta has been delivered and that it is complete. If there is a piece of the placenta missing, it could prevent the uterus from contracting completely. If you think there is a piece missing and heavy bleeding continues, consider exploring inside the uterus with a gloved hand. You can also assess for inversion or uterine tear; however, this is very painful for mom if no anaesthesia is available, and there is a significant infection risk. Broad-spectrum antibiotics should be given if available.

If the placenta has not been passed, you may try to gently guide it out with slight tension on the umbilical cord. DO NOT pull on the cord if the placenta has not separated from the womb! This is very dangerous and could result in maternal death. If gentle pressure on the cord does not result in its expulsion, you should consult one of the listed reference books for guidance on its removal.

If the uterus is empty and will not contract with nipple stimulation or rubbing, then bimanual compression should be considered. One hand is placed inside the vagina and the other hand is used to compress the uterus from the outside down onto the hand the vagina. This is painful and also carries an infection risk but can be lifesaving. Ice water lavage may also help slow bleeding – do this just like an enema.

If medications are available, then oxytocin or ergotamine are powerful stimulators of uterine contraction and should be used if your nipple stimulation and uterine rubbing fail. Oxytocin will stimulate powerful uterine contractions—be very sure there is not another baby present before you give this drug. Ergotamine is a derivative from the rye fungus ergot (Claviceps purpurea). Historically midwives used to give the black mouldy rye infected with this fungus to a woman who was labouring slowly or who had post-partum bleeding. The reality is that while ergot is excellent for controlling post-partum haemorrhage, if it is given to pregnant or labouring women it is likely to cause foetal distress and possibly foetal death. Like any botanical medication, establishing the correct dose can be difficult and an overdose of ergot can cause vomiting, and severe hypertension, and possibly stroke.

Anything other than a simple repair job should be covered with antibiotics due to high infection risk.

Most bleeding will be controlled with patience, uterine massage, breastfeeding and avoiding panic. Repair tears as needed and ensure there are no retained placenta fragments. It is terrifying to watch a post-partum hemorrhage, often appearing like someone has turned on a tap – **DON'T PANIC!!**

Caesarean Sections:

Whether this is an option for you is very much dependent on your skills and your ability to give an anaesthetic – either general or local. Untrained people attempting something like this is high risk. Decision making around surgical practice in grid-down/high risk circumstances is discussed in more detail in the surgery chapter. Obstetric anaesthesia is high risk even in the hands of an expert. A couple of general points:

- It is possible to perform a caesarean section under local anaesthesia (local infiltration as opposed to spinal or epidural anaesthesia) with and without sedation. How practical this is depends to a degree on the mental state of the woman. While removing most of the pain sensation, it does not remove the sensation of pushing and pulling associated with handling the internal organs. This can be a very unpleasant sensation for some women. However, evidence from Africa suggests that it is a viable option in a low-tech environment.

- The standard incision for a caesarean section is a horizontal lower abdominal incision followed by a horizontal incision over the lower segment of the uterus. This results in a stronger scar on the uterus and a better cosmetic skin incision; however, it is not the easiest approach. In an austere situation the skin incision of choice is a large up/down midline incision from just below the umbilicus to the pubic bone. Then an up/down incision over the body of the uterus, the so called "classical" incision. This approach is considerably easier for the novice from an operative point of view. The scar on the uterus is not nearly as strong, though, and there is a significant risk of rupture if the woman subsequently goes through another labour. Aseptic technique and sterile operating equipment is a must with this procedure, and if bypassed will leave the mother in grave danger. Antibiotics are certainly indicated, if available.

What happens if the baby cannot be delivered?

If you have an obstructed labour, mal-positioned baby, or the baby is dead, the first choice is to perform a caesarean section. If this is not possible, then delivering the baby in pieces may be the only option to save the mother. As unpalatable as it sounds, if nothing is done the mother will die of sepsis. If the labour is prolonged with the head deeply embedded in the pelvis, pressure injuries can occur in the mother's pelvic floor, causing a fistula (hole) between the vagina and the bladder or bowel to occur – these are very common in third world countries and very disabling.

This is extremely unpleasant but can be done with a sterile wire saw and scissors. The baby's head is decompressed through one of the two fontanels' (soft spot/holes) in the skull – this is unpleasant process, but essentially involves cutting open the skull and removing the brain so the skull collapses, this may allow the body to be delivered or the body is removed in pieces. This is rarely required and is a last ditched solution to save the mother, as in a major disaster situation with no conceivable access to health care. If not done in a sterile manner infection will be introduced and will likely prove fatal to the mother.

Neonatal Care:

When the baby is born, dry him off with a clean towel and then place him on his mother's belly. The most important thing for a newborn baby is to stay warm and this is best done with skin to skin contact with his mother. Cover the baby and keep him away from drafts. As the baby begins to nurse, you can check is health. Watch is breathing, heartbeat, muscle tone, reflexes and color. A baby may be slightly blue in color just after birth, but they should become more normal in color within 1 or 2 minutes.

If a baby is having trouble breathing, rub your hand firmly up and down her back. Never hit her or hold her upside down to make her cry. The next step is to lay the baby on a flat surface and place a small rolled-up cloth under her shoulders to tilt the head back slightly. Check her mouth to make sure there is no thick meconium present; if so, suction it out. You may give small puffs of air into the baby's mouth to open the lungs and stimulate breathing.

If the baby is breathing normally, he should breastfeed as soon as he is ready to eat. The first milk a mother makes is called colostrum, which is thick and yellowish. This is a very special type of milk that will help prevent the baby from infections and he should nurse this milk soon after birth. If the baby is not breastfeeding easily, check for mucus in his nose.

Post-Partum Care:

Once the baby has been delivered and is suckling happily, you should tend to a few things before leaving the mother. Gently clean the mother's genitals, belly and legs, wiping down from the vulva to prevent contamination with fecal material. Remove any dirty bedding that is present.

The next thing is to ask the mother to urinate. A full bladder can cause bleeding and other problems. She should need to go within 2-3 hours after delivering.

Offer the mother something to eat and drink. Most of them are ready soon after birth and they may have any nutritious food they want. If she is not hungry, she should at least have something to drink. If she will not eat or drink after a couple hours, she may be continuing to bleed or have an infection.

Monitor the mother and baby for several weeks after the birth. The mother's bleeding should slow down to about the amount of her monthly bleeding or less. Her bleeding should stop completely after about 2-3 weeks and her womb should get smaller every day. Watch her for signs of a uterine infection—fever, chills, heavy bleeding, bad smelling discharge from the vulva, abdominal pain or feeling ill. A uterine infection is very dangerous and can quickly kill a woman. She must be treated with antibiotics quickly.

The baby should breastfeed every few hours. Keep her warm and dry and play with her. Consult Chapter 12, the children's chapter, for more specific considerations on newborns.

A Book for Midwives **by Klien, Miller & Thomson, published by the Hesperian Foundation and updated in 2013 is the best single source of information on family planning, delivery, problems, and newborn care in an austere environment.**

Chapter 13: Considerations in Children and the Newborn

This is a bit of a potpourri of a chapter. We have across the book dealt with kids issues as part of each chapter and 90% of the comments which are directed at adults also apply to kids. But there are some special considerations and illness unique to childhood which merit their own chapter.

It is important to understand that children are different – just look at how they look, behave, think and speak and its blindly obvious they are different! They even have their own special area in medicine know as Paediatrics. They have important differences of anatomy and physiology and a small group of diseases which are unique to childhood, but while acknowledging these difference is important, broadly the principles of good medical care and resuscitation are the same regardless of the age of the patient – and this is a key concept.

If you apply the same basic principles – allowing for a few simple differences - you will end up doing the right thing for most your patients.

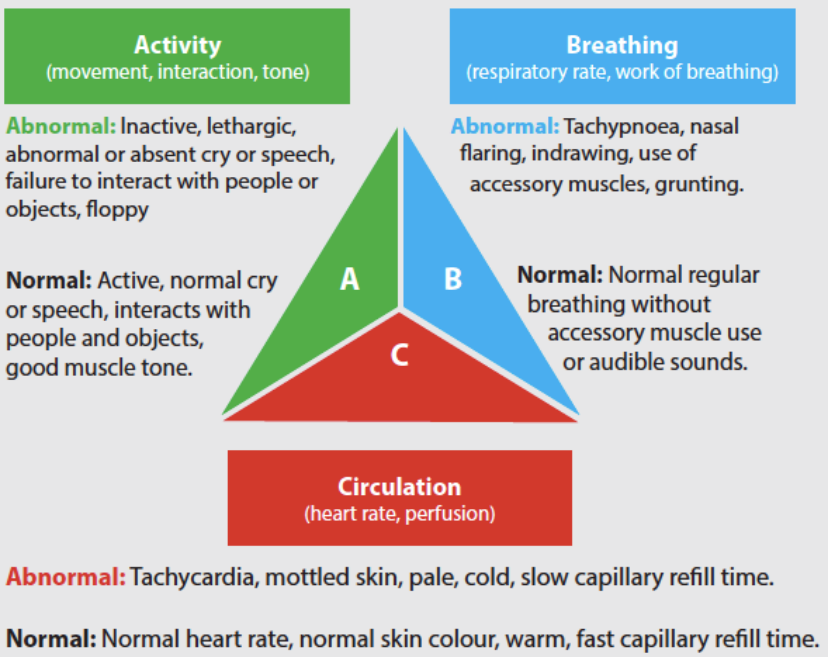
There are some important differences and diseases it is worth knowing about. This is by its nature a superficial introduction, but hopefully will identify some of the key differences and uniqueness of sick and injured children.

A. Assessing sick children:

The same basic principles apply to assessing children as assessing adults. However, identifying who is unwell and who isn't can be more of challenging with a child.

Children that are scared or in pain regress. A child who is 8 or 9 and is stressed and upset can behave like a 4 or 5-year-old and a 5-year-old can regress to behaving like a toddler. Understanding this is big step to understanding and dealing with a child in an emergency.

One tool, which can be useful to identity a truly sick child from one who is just moderately unwell, is the Paediatric Assessment Triangle (PAT).


Activity
(movement, interaction, tone)
Breathing
(respiratory rate, work of breathing)
Abnormal: Inactive, lethargic, abnormal or absent cry or speech, failure to interact with people or objects, floppy
Abnormal: Tachypnoea, nasal flaring, indrawing, use of accessory muscles, grunting.
Normal: Active, normal cry or speech, interacts with people and objects, good muscle tone.
A
B
C
Normal: Normal regular breathing without accessory muscle use or audible sounds.
Circulation
(heart rate, perfusion)
Abnormal: Tachycardia, mottled skin, pale, cold, slow capillary refill time.
Normal: Normal heart rate, normal skin colour, warm, fast capillary refill time.

There are three aspects to the assessment: activity, respiratory and cardiovascular.
If there is no abnormality to the PAT, it is unlikely there is anything seriously wrong with the child.

- One part of the triangle is abnormal – the child is unwell, but probably not overly unwell – what part of the triangle is abnormal directs you to the system which is abnormal.

  If breathing is abnormal but activity and circulation are normal it is likely a respiratory illness or injury that is the problem. If activity is abnormal, but breathing and circulation are normal it is likely the problem is with the child's brain. If perfusion is abnormal but breathing and activity is near normal, the child probably has a primarily problem with the heart or circulation.

- Two parts of the triangle are abnormal – the child is very unwell and has potential to deteriorate – ignore at your peril!

- All three parts of the triangle is abnormal – the child is life-threateningly unwell and immediate action is required to save that child's life.

Fortunately for most children, due to the fact they have relatively pure undamaged bodies, they respond well to basic resuscitation techniques:

- Open and maintain their airways
- Help with their breathing. Give oxygen if required and available
- Support their circulation with fluids if signs of poor perfusion – oral, IV, rectal, anyway which works

- Make sure their body has access to plenty of simple carbohydrate to run their systems – sugary water, if unconscious smear it on their gums. Honey is useful as it is sticky – smear it around their gums hourly.

Apply the same basic rules as for adults and often kids bounce back very quickly. They can become unwell quickly, but they also bounce back quickly. Focus on the simple things above and for many unwell kids it will be enough.

Drug Dosing in Children:

Many medications come with specific dosing instructions for children as part of the packaging, if they do, then follow these. However, many rely on the fact you will know how to calculate the right dose for size of the child and assume you will have access to one of the many drug formularys which list what the dose is for any given size and in any given circumstance. If you don't have access to one of these books then the "20% rule" will give you a safe approach to dosing children. Using this rule, you will not overdose the child by giving them too much medication. With some drugs (such as antibiotics where we tend to give a bigger fraction of the adult dose) you may slightly under-dose the patient. However, it is a safe approach when you are not 100% sure on the right paediatric dose.

Take the adult dose and based on the estimated weight of the child apply the following percentage fractions of the adult dose.

10 kg (22 lbs)	20% Adult dose
20 kg (44 lbs)	40% Adult dose
30 kg (66 lbs)	60% Adult dose
40 kg (88 lbs)	80% Adult dose
50 kg (110 lbs)	100% Adult dose

The only common exception is the penicillin- based antibiotics where, due to excellent elimination of the drug, the above values are doubled. There are other exceptions, but this approach will safely cover most paediatric drug doses.

A. Childhood Illnesses:

For the most part kids have the same illnesses as adults and react in broadly the same way, allowing for the differences described above. But there are a couple of specific illnesses which are unique to childhood it is worth talking about.

1. Diarrhoea and Dehydration:

Not a unique illness as such, but special for the number of children that it kills every year in the third world – most of these deaths are preventable and diarrhoeal illness is discussed in more detail in Chapter 7.

2. Bronchiolitis:

This is a respiratory disease caused by several different types of virus affecting children under 2 years of age.

While not a pure disease of poverty, it occurs more often in poor families in crowded living conditions and is associated with household contacts smoking.

Classically, the child presents a runny nose, a mild fever, an unproductive cough, and worsening difficulty in breathing. Normally the child is at their worst on day 3-4 and usually improves from there.

While some children require oxygen therapy to survive, most who become seriously ill do so because they fail to get adequate fluids into themselves and become dehydrated.

The ideal treatment is supplemental oxygen (usually only 1-2/l min) to maintain oxygen saturation and a real focus on ensuring hydration. If the child's respiratory distress is too severe to be able to drink, they may require a nasogastric tube (or a rectal tube) to administer hydration to them during the peak of the illness.

There are no evidence other drugs like Albuterol/salbutamol or steroids make any difference to the length or the illness or how quickly they get better.

3. Viral and Bacterial Diseases of Childhood:

A high fever with a blotchy red rash in children is common and could be due to many viruses. Most are benign – they cause a mild rash, a fever and variably a sore throat, a headache, or achy joints. Provided the child is drinking well and awake and alert, there is no real cause for concern and most settle over 3-5 days and the exact cause is never known.

There are several specific viral diseases of childhood which can potentially cause serious complications and it is worth knowing a little more about these.

Measles

Measles is a viral illness caused by (not unsurprisingly) the measles virus.
It is vaccine-preventable and is an unpleasant and dangerous disease – if possible vaccination against measles should be ensured (see chapter 7) for further discussion about vaccination)

It has a very particular pattern and can usefully be recognised even by a lay person. This is important as it is highly contagious – recognition and quarantine is the first step to controlling its spread. It is spread by contact with respiratory secretions – so contact saliva or snot from infected children.

In the first world, the death rate with measles is about 0.2% and the serious brain injury rate is about 2%. In a malnourished population, the death rate can be as high as 10% - so the risk in an austere environment is high. Those at most risk are children under 5 years.

The classic presentation is very high fever (>40degC/104.0degF), cough, runny nose and red inflamed eyes. Followed by the development of small white spots on the inside of the cheeks (Koplik spots) and a widespread red (but not raised) rash which starts on the face and spread over the body over 24-48 hrs – which starts usually 3-4 days after onset of the other symptoms.

The two life-threatening complications are a viral pneumonia and inflammation of the brain (encephalitis) which occur in about 30% of patients infected.

Treatment is supportive: maintaining hydration and generally supportive nursing care. It is a viral infection and no antibiotic will help. There is some suggestion (particularly in malnourished children) that vitamin A is useful if available – it is found in high concentrations in fish and animal liver.

In 1980 Measles accounted for 20 million deaths per year in the third world. With an aggressive vaccination campaign this has been reduced to 70,000 in 2014.

Chicken Pox

This is discussed in more detail in the Clinical FAQ chapter.

Importantly, for the clear majority of patients who catch chickenpox, the treatment is simply time and simple measures – make sure the patient stays hydrated and simple pain medicine like paracetamol (Tylenol) for the aches and pains.

Diphtheria

Diphtheria is an infection caused by the Corynebacterium diptheriae bacteria.
It is a vaccine-preventable disease and is included in most countries' vaccination schedules.

Presentation. Classically it presents 3-5 days after exposure with a slow onset of sore throat and fever. It can be a challenge to tell mild diphtheria from a viral or bacterial strep throat.

More severe illness is usually distinguishable – it classically includes a severe sore throat, very large lymph nodes in the next and at the most severe end of the spectrum a grey/white membrane coating the back of the throat potentially obstructing the airway. Note: a normal bacterial throat infection may cause a white material to appear on the tonsils – with diphtheria, this membrane spreads across the back of the throat (see picture). The patient may present with a croupy ("barking like") cough and may noisy breathing – making a high-pitched whistling sound when they breath out (stridor)

pseudomembrane seen in diphtheria. Wikipedia

Treatment is simply with penicillin if it is available – the bacteria is highly sensitive to this antibiotic.
In the event of an airway obstructions the patient may require a surgical airway (described in chapter xx).
The historical treatment for this was literally reaching back into the patients mouth and doctor scraping out the grey/white membrane with their fingers.

Diphtheria may cause may present in other ways (like skin sores) but this is almost impossible to recognize in an austere environment. The damage is caused by a toxin produced by the bacteria, not by the bacteria itself.

Polio

Poliomyelitis is vial disease, called by the Polio virus. It is a vaccine-preventable disease and prior to widespread vaccination was a major cause of severe disability and death.

In most people, they experience a minor viral illness with low grade fever, myalgia's and cold like symptoms, diarrhoea and abdominal pain.

In 1% of patients it enters the central nervous system and causes a more severe version of the disease.

In 50% of patients it causes non-paralytic CNS polio which is characterised by headache (they have a type of meningitis – but viral so antibiotics will not help), neck pain, back pain, extremity pain and severe GI symptoms. This is generally self-limiting.

In the other 50% (or 5 in 1000 of the total number who develop polio) it causes paralytic polio. Initially the patient develops a severe headache, stiff neck and muscle weakness (affecting different muscles) – they may develop difficulty swallowing, difficulty breathing and difficulty mobilising.

The paralysis generally begins 5-10 days after the initial symptom onset. There is no specific treatment, and is based on supportive care.

We see two syndromes in paralytic polio:

Bulbar polio:
This is where the infection attacks the brainstem and interferes with breathing and swallowing. For most people problems with swallowing and breathing last 10-14 days before the patient can breathe spontaneously. This potentially involves ventilating the patient for 2 weeks which is technically challenging and may be impossible for most groups. Regardless, a number (and it is a variable percentage) will not recover and will die.

Spinal polio
In these patients, the polio virus enters the spinal cord and permanently damages it resulting in weakness and paralysis. Any limb or combination of limbs may be affected – one leg, one arm, both arms, both legs.

Polio is often fatal in an austere environment.

Whooping Cough

Whooping cough (or the 100-day cough) is a bacterial infection caused by Bordetella pertussis characterised, like most mild respiratory illnesses, by a fever and mild cough – the body normally clears the infection quickly and effectively. The problem is the bacteria produces a toxin which damages the cells which lines the airways/breathing tubes – many cells die or are badly damaged – it takes up to 3 months for the cells to heal or be replaced. It is vaccine-preventable.

In adults and older children it is mostly an annoying cough which persists for up to three months (hence the 100-day cough name) – the coughing can be distressing and often leads to the patient coughing so much they vomit. They are also at risk of developing pneumonia. The patients can become quite unwell, but it is not usually fatal in this group.

The group at highest risk is smaller children and infants. In children under 1 admitted to a modern hospital in the western world with whooping cough today, mortality is 1.5%. Twenty percent of this age group also develop pneumonia.

When coughing, these children cannot be fed properly or breath properly – the consequence is that if they have the illness particularly severely they may become dehydrated or not get enough oxygen and may die. A number also develop (and die from) a brain injury due to the constant coughing.

3. Reduced Level of Consciousness (LOC) in Children

This is fortunately uncommon in children. Assessing conscious state is discussed in chapter 6. The exact diagnosis can be a challenge in the absence of modern medical technology. In an austere situation, we apply some basic rules to help us:

1. If possible, measure the child's blood sugar. If low (or if you are unable to measure it at all) then treat the patient using a sugar solution or honey smeared on the patients gums every 5-10 minutes to see if there is a response.

2. Reduced conscious state + fever = assume it is meningitis (an infection of the coverings of the brain) or a severe infection elsewhere = antibiotics, fluids and good nursing care.

3. Reduced conscious state + low temperature – below 34 degrees C (93.2 degrees F) – consider hypothermia as a cause and passively warm them up and see if this improves their conscious state.

4. Trauma (a bang to the head) + reduced LOC = a shaken brain or bleeding inside the skull. In an austere situation "wait and see" is the only real option. Focus on providing good nursing care and nutrition, and time will declare if the child will recover or not.

5. Are there any other signs of blood loss or dehydration? Children, when they are shocked or badly dehydrated, can become quiet and withdrawn and sleepy.

6. Have they been exposed to any toxic chemicals? Could they simply be drunk? Do they have access to alcohol?

7. In younger children, (<7-8 years) is this behavioural – has something happened to the child to trigger this either acutely or potentially as part of a PTSD response. Has the child's behaviours been unusual prior?

These may not always identify the cause – but they are listed to give you some focus on potentially treatable causes. Many causes are hard to diagnose and harder to treat in an austere situation, but like many things discussed in this book – focus on what you can fix.

B. Newborn Babies

The basics of childbirth and the management of some complications are discussed in the Woman's Health Chapter, chapter 12. While children are for the most part just little adults (despite what Paediatricians will tell you) – this general statement doesn't apply to newborns – they are special and behave quite differently – the exact reasons for this are beyond this book.

Birth.

The key issue at birth is getting the baby breathing and then keeping it dry and warm. Lots of babies don't breathe immediately at birth. All most need is reasonably vigorous stimulation after being wrapped in a warm dry cloth. Don't forget to change to a second towel after drying and stimulating the baby – otherwise the now damp towel will cool the baby.

If the child is still not breathing after this then begin mouth to mouth (a newborn baby literally just needs a adults mouth full air – a puff) or use a bag-mask device to assist with ventilation. If they have a heart beat then usually a few breaths is all that is needed. A child which doesn't respond to vigorous stimulation and 3-4 minutes of rescue breathing is likely going to die. If they are not breathing and their heart rate is < 60 then start CPR. If they don't have a heart beat and don't have one after 3-4 minutes of CPR they are dead.

If you are interested in the full medical resuscitation of newborns and have access to more equipment and drugs, there is more info here: http://www.resus.org.au/ . Click on "guidelines", then "read only versio", then scroll down to "neonatal".

Like an uncomplicated labour and delivery, the care of most newborns is relative straightforward. Their needs immediately post-delivery are simple:

- They need to be kept warm – skin to skin contact with mum is best, with a blanket over both.
- They need to be breastfed – the initial milk the breast makes in called colostrum – mum will only make a small volume and it is high in fat and provides a vital source of energy. Babies who are slow to breast feed or struggle to latch on may need to be feed formula if available or have sugary water smeared on their gums to provide energy.
- Early breast feeding is good for mum too, it causes the release of oxytocin in the mum to help contract the uterus and reduce bleeding.

For most babies if these things are done the baby will thrive.

There are a few complicated congenital conditions – effecting 2-3% of newborn babies – which in a low-tech situation cannot be diagnosed before delivery which are potentially fatal. If the above simple care cannot get them going and they remain lethargic and floppy – the management options in an austere environment are limited. It is worth persevering with the above – and for some it will be enough – but other will die. But no baby should be allowed to die without the above basic care being tried aggressively.

i. The umbilical cord.

Tie it off with nylon and cut it off about 5-6cm (2 in.) from the baby.

Provided you keep it clean and dry it will drop off after 5-10 days. While it is still attached it occasionally looks a bit mucky around the base. This should be cleaned with a warm damp cloth. If it becomes red and angry looking around the base if possible the child should be treated with antibiotics – Flucloxacillin or Amoxycillin are good choices. If no antibiotics are available then keep it clean and dry.

ii. Breastfeeding

An infant's ability to survive depends on its ability to get milk. For the first six months, a baby only needs milk.

Breasting feeding is the Gold Standard by a considerable distance for nutrition for children in the first 6 months of life. It is also the ideal survival food requiring no space or rotation and is readily portable and always the right temperature!

The most reliable method of ensuring the baby is getting sufficient milk is their general contentment and steady weight gain. While there are many causes for irritable babies, when combined with poor weight gain it suggests inadequate nutrition. A common cause is insufficient breast milk although other nutritional problems can present in a similar fashion.

If the mother's milk supply is insufficient or falling off there are several options. The first is the "wet nurse" concept. This was very common practice until the advent of commercial infant formula in the last century. If the mother had insufficient milk for the baby then another lactating woman fed the baby. There were women who did this as a career, and in upper class England this was common so the aristocratic woman could "preserve" her figure. In an austere situation, this is only an option if there is another breast-feeding mother in your group either with enough spare milk or an older child who can be weaned.

Secondly it may be possible to induce lactation in a non-breast feeding woman. Nipple stimulation to simulate sucking 3-4 times per day can lead to the onset of milk production after 7-10 days. This is more likely to be successful and to occur earlier in women who have previous had children and had breast-fed for longer periods.

In the absence of formula, if a baby is unable to breastfeed they will die. If for some reason the baby is unable to latch on to the nipple it is possible to feed them expressed breast milk (EBM). This is usually done using a manual or electric pump, however, it is possible to milk the human breasts in a similar fashion to milking cows! EBM can only be stored unrefrigerated for a couple of hours. It can be given to the baby via a bottle and teat (nipple) or from a cup – even newborn babies are able to sip from a cup although this may take a little practice. They can also be finger feed – this is where you tape a very fine tube to your finger the other end of which is placed in the formula or EBM. The baby sucks on your finger and sucks milk up the tube – commonly used sizes are 6 or 8 French. Failing that a clean piece of absorbent material can be placed in the EBM or formula and then the baby can suck on this.

Commercial formula is an acceptable and safe alternative to breast-feeding. If you have infants or plan on having children, it is important that you give some consideration to what you would do if you were unable to breast feed the infant. The unfortunate fact is that storing and rotating 6 months' worth of infant formula may be prohibitively expensive for most and this is a risk you may need to live with.

In a truly austere situation it is possible to make infant formula from stored food although this is clearly sub-optimal. The following table contains several recipes for using stored food components to manufacture baby formula – please accept the caution that this is only for a life-threatening situation where there are no alternatives and the baby will otherwise die.

1. 1 x 13 oz. can of evaporated whole milk
   2 tablespoons of table sugar
   19 oz. of safe drinking water
   1 ml liquid infant vitamins with iron OR ¼-1/2 adult daily multivitamin with iron crushed to a powder (a poor second)

   Mix thoroughly, keep sealed, and use within 24 hours.

2. 3.2 oz. dry whole milk powder
   2 tablespoons of table sugar
   32 oz. safe drinking water
   Vitamins as in 1

   Mix thoroughly, keep tightly sealed, and use within 24 hours

3. 3.2 oz. dry non-fat milk powder
   2 tablespoons of table sugar
   3 tablespoons (28gms) of vegetable oil
   Vitamins as in 1

   Mix thoroughly, keep tightly sealed, and use within 24 hours

(The Prudent Pantry; Alan T Hagan, Borderline Press 1999)

iii. Premature babies

It is hard to predict how young a baby can be and still survive in an austere situation. Babies as young as 32-34 weeks have survived in low-tech environments. Before then the chances of survival without intensive support is very low.

Premature babies generally need warmth and nutrition. Both can be delivered in low-tech ways to babies over 32-34 weeks. A large percentage of premature babies at this age will have more complicated health needs, those babies requiring more than this level of basic care will not survive.

iv. Infections in newborn babies

Temperatures >38.°5C (101.3°F) in a child < 1 month old is a cause for serious concern. A significant percentage it is due to the child being over-wrapped. However, 10-20% of times it is due to a serious bacterial infection. In a survival situation, it is impossible to know for sure.

A general rule would be that a happy feeding baby who only has a brief temp that goes away when some clothing is taken off or the environment is cooled, and remains happy and continues to feed is probably ok.

If fever persists or the child is off its food for >4-6hrs then antibiotics should be given. The antibiotic of choice is simple Amoxycillin. Ideally IV – if this is not possible, then orally is acceptable.
If you don't have any antibiotics focus on maintaining hydration with expressed breast milk.

v. Colic and reflux

Some babies are miserable from a birth (or a couple of weeks of age) for 2-3 months. They cry and grizzle for hours at a time and are difficult to settle. The main issues are to ensure that they do not have an infection and are getting enough milk. Provided they continue to grow and put on weight they are probably ok, even if crying frequently.

vi. Runny noses

These are very common, even in children who are relatively social isolated. The problem is the baby must breath through their nose to feed. A blocked nose = difficulty feeding. There are a couple of options for clearing out the mucus – sucking it out yourself – exactly what it sounds like (it works well) or placing about 1ml of Normal Saline into each nostril – water doesn't work – which makes them sneeze, but also loosens the mucus.

vii. Not gaining weight

You need to be able to weigh your baby accurately. Some sort of scale is vital. This is the most accurate way to know if your breast-fed baby is getting enough nutrients.

The most common reason for poor weight gain in a breast-fed baby is insufficient milk. If that is the case you may need to consider other options. Failure to thrive can also occur with a host of nutritional and metabolic diseases – you have limited options here. Ensure a good milk supply via EBM or formula and hope for the best.

viii. Serious problems

About 1:50 newborns have a serious problem from which they will die without surgical intervention. This includes children who have serious congenital heart defects or abnormalities of the gut. The only condition for which surgery is potentially an option in an austere situation is for Pyloric stenosis – which is an outlet obstruction of the stomach. The corrective surgery for this is very simple, but still requires and anesthetic and some basic surgical knowledge – but not much in the way of instruments.

There are also a whole host of genetic conditions which can present any time from birth to adulthood which are potentially fatal and are well beyond the scope of this book.

Chapter 14: Austere Dental Care

In an austere or survival situation the ability to provide even limited dental care will be an extremely valuable trade commodity – a license to print money. The educational resources for dental care by non-dentists are limited. "Where There Is No Dentist" by Murray Dickson (see references) is the best single book around. The first edition is limited in the details of its coverage of dental anesthesia and modern filling materials, but, this is rectified in the second. It is an excellent and easy to understand introduction to dental care.

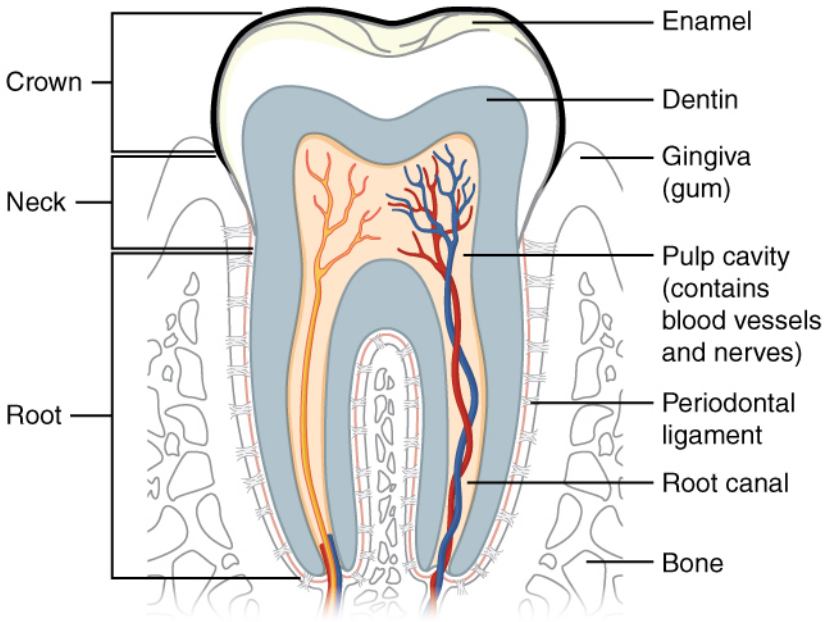
There are several other good web-based resources (links working as of 12/17):

Common Dental Emergencies: **http://www.aafp.org/afp/20030201/511.html**

Merck Manual Dental Emergencies:
http://www.merck.com/mrkshared/mmanual/section9/chapter107/107a.jsp

Like much in this book the following information is offered for interest only and is no substitute for professional dental care. **Much of this information is useless without detailed anatomical knowledge and instruction in actual techniques.** We are not trying to teach dentistry here but are providing an overview of what is possible in austere situation, and helping you focus your preparations and further education.

Anatomy of a tooth



Anatomy of a tooth. Wikimedia commons

The anatomy of a tooth is relatively simple. Each tooth is of a similar structure, although the shape may vary. The outside of the tooth is covered in a hard surface layer known as enamel. When intact this layer makes the tooth insensitive to hot or cold. This is overlying the softer structural material of the tooth known as dentine. This layer is sensitive to hot and cold – so hot and cold sensitivity can be one of the first signs of a cavity. Beneath the dentine is core – known as the pulp with has the blood supply and nerves for the tooth in it. When exposed to air and the bacteria of the mouth, exposed pulp hurts. If the pulp is inflamed or infected, pressure on the affected tooth will cause pain

The basics of dentistry can simplistically be broken down into 7 areas:

1. Preventive Dentistry:

Like preventive medicine the importance of preventive dentistry cannot be over emphasized. Before finding yourself in an austere environment get in the habit of daily brushing and flossing, and regular dental check-ups and appropriate treatments.

People are generally bad at this.

When access to regular dental care is no longer possible continuing with daily flossing and brushing is vital. High sugar foods and drinks particularly between main meals should be discouraged. Brushing alone is insufficient – you must floss as well.

2. Scaling and Cleaning:

This is simply an extension of preventive dentistry. While regular cleaning and flossing will minimise and slow plaque build-up, it will still occur. This takes the form of mineralised deposits at the edges of the teeth and the gums, and just below the gum margins. This material is difficult to remove with simple brushing.

Scaling is the process where this material is scraped off using a scaler or dental pick. It is usually a relatively straightforward process.

3. Dental Pain and Infection:

Dental Pain

Pulpitis – inflammation of the dental pulp = toothache

This pain is often referred to surrounding area or radiates to other teeth. It can be difficult for patient to ID the exact tooth which is originating the pain. The tooth is usually not sensitive to percussion or palpation but maybe sensitive to heat, cold, sweets.

Frequently there is an obvious cause, e.g. a large cavity. Management is by symptom control with oral anti-inflammatories and pain medications, local nerve blocks, cold packs, saline gargles, and soft diet. This management is standard for many of the common conditions and will be referred to as "standard dental first aid" in the rest of this chapter.

Periapical Inflammation – Inflammation, but not infection, at the apex (root base)
The involved tooth is usually is easily located. The tooth may protrude a bit and/or cause pain with chewing. Usually there is no obvious external swelling as is the usual case with infection. Management is as for pulpitis.

Aphthous Ulcers – Lesion on oral mucus membranes, cause unclear.
There are often multiple ulcers lasting 7 – 15 days. May be triggered by trauma, stress. Management is with standard dental first aid. Topical steroids may shorten course of healing.

Muscle Pain & Spasm – chewing muscle dysfunction due to teeth grinding, jaw clenching, heavy chewing, etc. Management by muscle rest, soft diet, anti-inflammatories.

Other Causes
Infections (discussed below), facial nerve pain, herpes zoster, vascular pain-migraine, sinus pain, referred pain.

Infections:

For all perioral and intraoral ulcers and infection an oral rinse of hydrogen peroxide can be useful. Neat hydrogen peroxide is to concentrated, to have in the mouth there are two ways suggested to dilute:

1/3 Hydrogen peroxide / 1/3 Water / 1/3 Listerine mouth wash
1/3 Hydrogen peroxide / 2/3 water

NOTE. Hydrogen peroxide is not safe to swallow and is essentially a "topical" treatment only

Herpes Labialis (viral) = cold sores on lips, tongue, gingiva, palate
Often triggered by sunburn, stress, and trauma. The patient often has a "prodrome" or tingle/pain before lesion presents. Management is by oral anti-inflammatories, and pain medications, soft diet. Antivirals such as Acyclovir 200 mg 5x/day can shorten course. Mouth rinse of equal parts Maalox, Benadryl liquid, and Viscous Lidocaine may be soothing, swish & spit out, use every 2 hours as needed.

Oral Candidiasis (fungal) = Thrush; caused by overgrowth of yeast normally found in the mouth
Often seen in the very ill, immunocompromised, or those on/recently taking antibiotics. It looks like white spots or patches throughout mouth, may have a "cottage cheese" appearance, can be rubbed off, the patient's mouth and throat often very sore & red. It is managed by eliminating source of re-infection

(toothbrushes washed in boiling water & air dried, etc.) and antifungal medicines. Topical antifungals like Nystatin Swish & Spit 5x/day or Mycelex Troche 4x/day. A good substitute is any sort of vaginal yeast cream rubbed into mouth & gums 4x/day. Oral antifungals like Diflucan 100 mg tablets 2x/day until it clears can also be used.

Bacterial Infections

Many different organisms can cause infections, often mixed aerobic and anaerobic bugs that are normally in the oral cavity. Infections can be life-threatening if the infection spreads to deep tissues or into the brain. Fever, local swelling, and lymph node swelling is common.

Apical Abscess/Cellulitis – Infection of the pulp extending down to the bone & gum. The gum and tooth base appear normal. This is an infection at the very apex of the roots that has eaten through the thin bone of the jaw. Notable for fever, pain, often an abscess/pus pocket, or swelling will form where the gum tissue joins the lip, no sensitivity to heat or cold. Management is by incision and drainage through the gum to the level of the bone. A small improvised drain such as a portion of rubber band or cotton wick, will speed healing – remove when no longer draining. Dental first aid treatment should be applied. Antibiotics may be required, see discussion below. Tooth extraction is indicated if not resolving despite treatment.

Gingival/Periodontal Abscess – Infection between the gum and the tooth. The abscess is usually on the cheek side. The tooth is usually sensitive to percussion but not heat or cold. Manage with incision and drainage and dental first aid. Antibiotics are usually not necessary.

Pericoronitis – Infection of the gum overlying a partially erupted tooth such as a wisdom tooth. It often occurs in the back reaches of the mouth. It can mimic a peritonsillar abscess or pharyngitis although there usually is no drainage or purulence with this. Muscle spasm in the chewing muscles is common also. It is managed by cleaning out between the tooth and gum and dental first aid measures. Antibiotics are usually not necessary. At times, removal of some of the redundant gum tissue may be helpful.

Deep Tissue/Fascia Infections – Any intra-oral infection can spread quickly through the relatively loose tissue planes to other areas in the neck causing tissue breakdown, bleeding, and obstruction of the posterior pharynx and airway.

Immediate incision & drainage is required along with aggressive antibiotic therapy and supportive care. This is a potentially life-threatening emergency, and you should try to get help if you possibly can.

When to use antibiotics:

Dental abscesses are best treated by drainage of any collection present. Antibiotics should be used in patients who are systemically unwell – high temperatures, chills or shakes, nausea, vomiting, or gross local swelling.

Penicillin 500 mg 4x/day or Erythromycin 500 mg 3x/day are usually acceptable antibiotics. Broader spectrum drugs can also be used. For patients who are very unwell the addition of the drug metronidazole 400 mg 3 times daily or Tinidazole 2 gm once daily to cover anaerobic bacteria may be

helpful. Amoxycillin and clavulanic acid (Augmentin) is ideal for moderate to severe infections and has good anaerobic coverage.

4. Drilling and Filling:

Cavities on teeth cause pain either because they allow infection into the inside of the tooth or they expose nerve endings in the pulp of the tooth which is stimulated by exposure to temperature extremes or extreme sweetness.

Recognizing a cavity is relatively straight forward on tooth surfaces which can be visualized – 'hidden' cavities between teeth which are difficult to visualize can be a challenge to identify and often are extensive and eroding onto an outer surface before they become visible.
A cavity is generally a darker color compared to the surrounding normal enamel – often it may even by brown or black. The cavity will be softer and a dental pick will generally go into the rotten enamel.

It is very straightforward to provide a temporary filling which covers the hole and protects the exposed nerve endings. This can be done with many temporary filling materials available on the market. IRM – a mixture of zinc oxide and eugenol [oil of clove] is considered one of the best commercial preparations which you can prepare yourself. It is prepared by forming it into a firm paste and "puttying" over the cavity with it. These agents are, however, temporary.

Permanent fillings are more complicated. They have traditionally required the cavity to be opened (frequently the hole on the surface of the tooth is small, with a much larger decayed area below), the decayed material removed, then the cavity sealed with a permanent filling agent.

It is unlikely that you will have access to a dental drill and associated permanent filling agents. However, the World Health Organization has developed a process known as Atraumatic Restorative Treatment (ART) technique – it has been around for 20 years and used extensively in the Third World. The ART technique involves caries (cavity) removal and simple tooth filling (or restoration to use the correct term) with adhesive filing materials using hand instruments only, no drills. It has been specifically designed to be delivered by people with limited experience in dental procedures and often provided under primitive field conditions. This makes it ideal for a survival or austere situation. This is a step beyond temporary fillings and while they may not last a lifetime they may (and do) last many years. The equipment to perform ART should be seriously considered as part of your preparations.

An overview of the process is described below and more detailed information is described at:

Atraumatic Restorative Techniques Step By Step .pdf: (working link 12/17)
https://www.mah.se/upload/FAKULTETER/OD/Avdelningar/who/art/artmanual/ARTManual2008.pdf

The process requires some basic equipment:

A glass ionomer: Fuji IX GP Glass Ionomer is one example.

Cotton pledgets + absorptive gauze: The work area needs to be kept dry from saliva.

Mouth mirror: This is used to reflect light onto the field of operation, to view the cavity indirectly, and to retract the cheek or tongue as necessary

Tweezers: This instrument is used for carrying cotton wool rolls, cotton wool pellets, wedges, and articulation papers from the tray to the mouth and back.

Explorer: This instrument is used to identify where soft carious dentine is present. It should not be used to poke into very small carious lesions. This may destroy the tooth surface and the caries arrestment process. It should also not be used for probing into deep cavities where doing so might damage or expose the pulp.

Dental Hatchet: This instrument is used for further widening the entrance to the cavity thus creating better access for the excavator, and for slicing away thin unsupported carious enamel left after carious dentine has been removed.

Spoon Excavator: This instrument is used for removing soft carious dentine. There are 3 sizes:
* small: diameter of approximately 1.0 mm
* medium: diameter of approximately 1.2 mm
* large: diameter of approximately 1.4 mm

Mixing block and spatula: These are necessary for mixing glass ionomer. These items are included with the Fuji IX pack.

Applier/Carver: This double-ended instrument has 2 functions: The blunt end is used for inserting the premixed glass ionomer into the cleaned cavity and into pits and fissures. The sharp end is designed to remove excess restorative material and to shape the glass ionomer.

The basic process consists of these stages:

1. If possible anaesthetize the tooth. Although the technique of ARM lends itself to being performing without any analgesia it can be painful. The painful bit is often opened up the cavity up to allow access to remove the soft rotten material. The larger the opening, the easier to perform the ARM
2. The first step is to open up the cavity with the dental hatchet so that you can get into the cavity properly.
3. Once the opening is enlarged, remove all the soft decayed material with a spoon excavator.
4. Mix equal amounts of restorative powder with the supplied liquid to make a thick paste.
5. Dry the cavity as best as you possible can. Dentists generally use short blasts of compressed air to blow any moisture out. Put backing around the tooth with gauze and dabbing the cavity is a workable alternative.
6. Push the restorative paste into the cavity hole, firmly and tapping it gently to get rid of any air pockets after placing the paste in the hole.
7. Have the patient bite down several times and ask the patient if it feels normal for them. If it looks or feels proud, vigorously rub it with a wet finger to take off any excess material. Note this needs to be done within a couple of minutes of insertion.
8. Filling on the "biting" surface of the tooth are easiest. Fillings on the front or back surface of the tooth can be done but are technically more difficult. Fillings between teeth are harder still and

may require some of healthy enamel and dentine on neighboring teeth to be chipped away to gain access to the tooth needing the filling.

This process results in filings which are not as robust as those done with the conventional techniques, and some parts of some teeth are impossible to access without the assistance of a dental drill..

While the technique is simple there are a number of things to be mindful of:

i. Smaller fillings do better than big fillings.
ii. A sore tooth to percussion or with associated gum swelling is not a good candidate for ARM.
iii. While undertaking the ARM, keep the cavity and surrounding area as dry as possible. The restoration will last longer the drier the area is.
iv. Gently tap out any air pockets. Pockets of air will result a greater chance of the restoration failing.
v. Make the filling as flush as possible. Over filling fill interfere with the patients bite and be uncomfortable.
vi. The materials do not cope well on load bearing teeth surfaces (which is the easiest surface to perform ARM on) but it does provide an alternative to extraction and may work well for years

If you are planning for a longer-term scenario in a truly austere situation it is worth looking at dental history for some options for drilling and filling.

The process of drilling involves a small rapidly turning bit cutting through overlying dentine to open a cavity. Different drill bits or other handheld instruments are then used to remove the decay. Drilling is painful, in part due to the speed of the drill (the more slowly the drill turns the more painful it is) and due to the heat generated by the drill bit. This is overcome with modern high-speed pneumatic dental drills with thousands of revolutions per minute (rpm) and spraying water on the tooth to keep it from heating up. Local anaesthesia can be used and often is; but with a modern drill it frequently isn't required. However, with a slow improvised drill it will be very painful without local anaesthesia. In improvising a dental drill, you should look back at the first dental drills from several hundred years ago. The basic concept was using a foot pedal (like an old sewing machine or spinning wheel) or bicycle to generate rpms on a wheel – the faster the better. This rotational speed then needs to be transferred to the hand piece with the drill bit attached. This can be relatively easily accomplished with a series of pulleys. Improvising the drill bit is potentially more difficult but in theory any small tapered metal tip (the head of a very small nail or tack) could be suitable.

Once you have overcome the problem of a dental drill you have the problem of finding a suitable restorative product. Gold is probably your best option. The use of gold film fillings has slowly faded over the last 20 years as better substances which are easier to place have become available. The basic technique is that the tooth is drilled, the cavity cleaned, a small ball of very (very) thin gold film is placed in the defect to be filled, and it is slowly tapped and moulded into place with a dental pick. The description makes it sound easy – it isn't, and learning the technique has psychologically scarred many a dentist.

Aside from gold film there is no permanent dental filling which can be easily manufactured in a low-tech way; in an austere situation extraction of the tooth may be the best option.

5. Dental Trauma:

Related Head & Neck Injury – Any blow or force strong enough to cause dental injury is potentially severe enough to produce injury to the head, other facial structures, and/or neck. Consider the possibility of cervical spinal injury, and evaluate ABC's (Airway, Breathing, Circulation) before getting focused or distracted by the dental injury.

Crown Chip – Small lines or "crazing" in the enamel. These are harmless. Some of these little chips and cracks can become sensitive to hot and cold – if available a "sensitive" toothpaste may be useful.

Simple Crown+/-Root Fracture – The tooth is fractured but no pulp is exposed.
This is usually not a problem although sometimes it can be cold sensitive. Smooth rough edges with a nail file and remove small fragments. If the tooth is especially sensitive Eugenol (clove oil) or IRM can be used as a topical covering plus dental first aid measures.

Complicated Crown+/-Root Fracture – The pulp is exposed but the root is intact.
Remove any fragments/pieces. Flush the area thoroughly with saline. If the pulp has been exposed for more than 24 hours remove about 2 mm of the pulp tissue. Seal the exposed pulp with Dycal, IRM, Glass Ionomer, or wax. Try to construct a smooth surface that will not irritate surrounding tissue or trap food particles. Plus dental first aid measures.Tooth extraction is an option if pain is not manageable or infection develops.

Root Fracture – A fracture below the gum line involving one or more roots. May be difficult to distinguish between this and luxation of the entire tooth (see below). Remove all fragments. If the entire crown is broken away do not attempt to extract the roots and apex. Reposition the tooth and stabilize by splinting with wire & brace bar, adhesive ribbon, or similar technique (discussed below). It takes a minimum of three months for the bone to heal. If necessary seal any exposed pulp tissue as above. Plus dental first aid measures. Tooth extraction is an option if pain is not manageable or infection develops.

Subluxation & Concussion – The tooth remains in normal position. In subluxation the tooth is abnormally loose due to damage of the periodontal ligament and gingiva; in concussion the tooth is only tender not loose. Avoid chewing on the loose tooth.
Excessively loose teeth may need to be splinted. Plus dental first aid measures.

Lateral Luxation – The tooth is intact but the root has been displaced breaking the surrounding bone. Often there is a bulge of the gum tissue indicating where the root has been pushed out of the socket. There may be a high metallic ring on percussion.
Place the tooth back into normal position by pushing the root back into the socket while pulling out on the distal portion in a "teeter-totter" motion. Splint the tooth if needed plus dental first aid measures. Tooth extraction may be required if pain is not manageable or infection develops.

Intrusion – The tooth is driven deeper into the socket. Use dental first aid measures.
Long-term tooth survival is poor. Tooth extraction if pain is not manageable or infection develops.

Extrusion – The tooth is partially pulled down out of the socket. The tooth is gently replaced into the socket and splinted if needed. Have the patient bite down gently to ensure that the tooth is all the way back in. Plus dental first aid measures. Tooth extraction if pain is not manageable or infection develops.

Tooth Loss – The tooth is knocked completely from the socket. Do not touch the root segment, or scrub the tooth, or the socket. Rinse the tooth with saline until clean, as well as the socket. Replace as soon as possible into the socket and splint. If immediate replacement is not available, store the tooth in saline, milk, or saliva. Implantation after 24 hours has little chance of success. Splint in place plus dental first aid therapy.

Segment/Jaw Fracture – Fracture of the bony structure of the jaw with 2 or more teeth involved. The teeth move independently of each other. Replace as with a subluxation and splint in place for 6 weeks.

Injuries to Primary "Baby" Teeth – Normally these are not repaired unless needed for comfort care of the patient. Plus, dental first aid measures. Tooth extraction if pain is not manageable or infection develops.

Soft Tissue Injuries – The tongue, gums, and oral mucus membranes are often injured at the same time as the teeth. The excellent blood supply promotes rapid healing, and infection is rare. Clean and thoroughly irrigate the wound with saline.
Laceration of ducts and glands can be difficult to repair and may cause ongoing problems – think in 3D when looking at facial injuries and considering what may have been injured. Close the tissue, preferably with dissolving sutures, as soon as possible. If unable to close the tissue within 12 hours, wait, and then close after 5 days when the wound bacteria counts have dramatically lowered. Ensure that the vermilion border of the lip is carefully repaired. For wounds, all the way through the cheek close the mucus membrane from the inside then close the muscle and skin from the outside in standard fashion. Use 2 sets of instruments if possible to minimize contamination of the wound with oral flora. Use standard dental first aid measures.

Intra-oral splinting:
Splinting can be required for tooth dislocations and fractures, and fractures of the mandible (the lower jaw bone).There are several techniques to temporarily splint a tooth dislocation or fracture:

Option 1. Wire suture material (or reasonably heavy gauge fuse wire) can be used to splint the tooth. The wire is glued to the affected tooth and to the neighboring teeth to provide stability.

Option 2. Cotton fibers can be mixed in with temporary filling mix and the resultant fibrous mix can be molded to make a splint between the injured tooth and its healthy neighbors.

For mandibular fractures or multiple involved teeth then full wiring of the jaw may be required 4-6 weeks. The technique is relatively straight forward:

- Using small lengths of wire suture (or fine fuse wire) make a small loop in the center of the piece of wire. Wrap the wire in a figure 8 pattern around two teeth, with the small loop facing outwards, over the gap between the two teeth. Repeat this top and bottom – in at least 3-4 positions – so you have the loops top and bottom-lining up.
- Wire each pair of loops (the top and bottom ones) together, so the jaw is unable to open.

- The patient will be on a liquid diet for the duration of the wiring.

6. Extractions:

Before antibiotics this was the main treatment for dental infections. An infection in the root of the tooth could only be treated by pulling the tooth and allowing it to drain.

The two basic underlying principles of dental extractions are very simple: first, the tooth needs to be loosened from its attachments to the gum and jaw – this is done by inserting an instrument known as an elevator between the gum and the tooth and working down 5-10mm and gently wriggling it back and forth to loosen the tooth. Then using an appropriate extraction forcep, the tooth is gently rocked backwards and forwards until loose enough to be removed. The key point is the gentle rocking rather than attempting to simply pull the tooth out.

While this sounds relatively simple, the reality is it can be much more complicated.

There are several things to consider: first, like setting a bone the process is very painful. There are a number of very effective local anaesthetic blocks which are easily used and are beyond the scope of this book.

Second: it can be difficult to grasp the tooth without the proper instruments although not impossible. The minimum instruments required to safely extract a tooth include a Maxillary Universal Forceps (150), Mandibular Universal Forceps (151), and a periosteal elevator. That said, it is possible to remove a tooth with any solid grasping instrument – such a pair of pliers – with the tips wrapped in gauze or in some other way padded – although this is not recommended.

Third: if the tooth's root(s) breaks (which is more likely with decayed teeth and if the operator is inexperienced) then it can be impossible to remove and the broken root fragment will act as a focus for further infection. "First do no harm."

Prosthetics:

The ability to chew food is fundamental to survival. In some primitive societies when you lost your teeth and lost the ability to chew, with the nature of their diet, you died – it potentially will become a problem again.

Your priority should be to prevent yourself or your families from getting to the point where you have no teeth. The only option you will have is making some form of dentures.

To manufacture dentures will require significant effort and improvisation skills. Historically porcelain was used to manufacture dentures until the end of the 18th century. Recipes for porcelain were considered state secrets in some countries. Porcelain is glorified clay, and is moulded, and then fired to produce a very hard material – there is varying recipes – one recipe consists of one part each of silica, clay, and kaolin, 2 parts of Nepheline syenite, and a small amount of talc. There are many recipes. Before this time

dentures had been manufactured out many substances including metal, bone, and animal and human teeth.

Dental Kits and Instruments:

Another area around which there are frequent questions is dental instruments. Practically speaking, you can remove a tooth with a pair of electrical pliers. However, if possible you should invest in some decent dental instruments. The instrument numbers are considered standard numbers but many companies have their own numbers or variations so check if you are unsure.

Level 1: Minimum Kit
This is the bare minimum that should be available. Note that all of this is obtainable at Wal-Mart, from many pharmacies, or similar stores. Often most of the components are sold as a "dental first aid kit".

Level 2: Basic Dental Kit
This is the minimum needed for basic dental work: temporary fillings and extractions. Where possible purchase supplies of high quality, they are reusable and will last for many years with proper care. Pretty much everything here is required for the kit as whole to be of value. The dental instruments are available from most medical instrument suppliers.

Level 3: Advanced Dental Surgery Kit
This is the advanced kit designed for those with some dental training and can do most needed dental work including fillings and extractions. Note that this kit builds on the basic dental kit and items can be added one at a time starting with the Flag or Cryer elevators, and Fuji IX ionomer cement, and building it up as skills and finance permit.

Note: Extractors 53R & 53L are mirror images of each other if you get the model with the straight handle. If you are nimble with your weak hand and can change sides on the patient you can get by with one or the other of the pair and save money and weight.

Note: Forceps # 18, 73, 75, 87, 201, and deep root elevators are of value also if you want to be complete.

Table 1 Basic dental kit

1	Dental mirror, plastic
1	Explorer or plastic pick/cleaner
1	Cavity or temporary filling material
1	Dental floss
1	Baby teething gel
1	Super Glue gel

T

1	Dental mirror
1	Explorer/probe double end #5
1	Angle point tweezers
1	Excavator, double-end #38/39 or 38/40
1	Plugger/filler, double-end #1/2 or 1/3 or similar
1	Elevator #301
1	Extraction forceps #150 universal upper
1	Extraction forceps #150 universal lower (can use #75 also)
1	Eugenol (oil of cloves) and zinc oxide powder, or IRM permanent filling material
1	Cavity temporary filling material
1	Scalpel handle and #11 & #15 blades
1	Needle driver, 4-5”
1	Scissors, Iris, curved
1	Copalite cavity varnish

Sutures; 4-0 or 5-0; silk, or, Ethilon, and chromic, or Vicryl, cuticular needle, 25 gauge stainless wire
Dental floss
Baby teething gel
Super Glue gel
Lidocaine 1% or 2%; syringes; needles
Irrigation syringe
Cotton balls & 4x4s

Table 3 Advanced Dental kit

1	Dental mirror
1	Explorer/probe, double-ended #5
1	Angle point tweezers
1	Excavator, double-ended #38/39 or 38/40
2	Plugger/filler, double-ended #1/2 and 3/4 or similar
1	Elevator #301
1	Elevator #34
2	Flag/Cryer elevators; 30 & 31 or 39 & 40
1	Extraction forceps #150 universal upper
1	Extraction forceps #151 universal lower (can use #75 also)
1	Extraction forceps #23 universal large molar
1	Extraction forceps #17 lower anterior
1	Extraction forceps #18, or #53R, or 53L upper anterior, see note below
1	Curette, Gracey scaler; 11-12
1	Curette, Gracey scaler; 5-6 or Ivory C-1
1	Bone rongeur
1	Bone rasp
1	Fuji IX glass ionomer ARM material
1	Eugenol (oil of cloves) and zinc oxide powder, or IRM semi-permanent filling material
1	Cavity temporary filling material
1	Scalpel handle and #11 & #15 blades
1	Needle driver, 4-5”
1	Scissors, Iris, curved
1	Copalite cavity varnish

Sutures; 4-0 or 5-0; silk, or Ethilon, and chromic, or Vicryl; cuticular needle, 25 gauge stainless wire
Reinforcement bars
Dental floss Baby teething gel, Super Glue gel
Lignocaine 1% or 2%; syringes; needles
Irrigation syringe
Cotton balls & 4x4’s

Chapter 15 The Basic Laboratory

The basics of a diagnosis can generally be reached by a careful history and physical examination. Modern medicine however relies heavily on laboratory investigations and in a survival situation these will not be available. There are however some simple laboratory aids that are within the realm of survival medicine that aid in coming up with a diagnosis and monitoring casualty care.

The survival medicine practitioner will need to make decisions about what level of laboratory medicine they wish to undertake. This could range from not having any laboratory aids to using commercially available point-of-care testing solutions to conducting some simple chemistry and microbiology procedures. What you are preparing for will dictate what tests you may want to be able to perform. It is also important to remember that not all laboratory tests are created equal. For instance, in an austere/survival medicine situation one is not really concerned about cholesterol versus the importance of knowing a blood sugar to rule out a cause of altered level of consciousness. When you are developing your laboratory, capability remind yourself that it is not useful to do a test that will not alter your treatment methodology.

The survival medicine laboratory practice can be broken up into sub-areas, which different slightly in usage then first world laboratory medicine practice:

1. Urinalysis (the examination of urine)
2. Bacteriology, Virology and Mycology (the examination of bacteria, viruses and fungus)
3. Hematology (the examination of/for blood)
4. Parasitology (the examination for parasites)
5. Transfusion medicine

Laboratory Practices.

If you are undertaking the operation of a small laboratory in a remote or austere survival setting there are a few fundamental practices you must understand/keep in mind:

1. If you are going to spend money, spend it on the things that are calibrated such as thermometers, scales/balances, flasks, cylinders, and pipets. If the tools you use to measure are not accurate your laboratory practice will suffer. Periodically check your tools for accuracy against other tools you know to be accurately calibrated.

2. Cleanliness is next to Godliness. Keep your glassware implacably clean/disinfected/sterile to prevent contaminants from producing false results. There are set practices on how to maintain glassware. Learn them and follow then religiously.

3. Use caution when handling specimens. Many of the things you are testing could be infectious and harmful to the laboratory worker if not handled appropriately. Use caution with sharps, wear goggles when there is a risk of spray, and respiratory protection when there is a risk of aerosolization. Have a

plan on how to deal with exposure to a specimen accidently on the skin or in the eyes. Do not allow anyone to eat or drink in the laboratory area. Have a plan on how to dispose of infectious laboratory waste. Also use caution with chemicals for reagents as many are acidic or alkaline and can cause severe burns.

4. Understand the scientific techniques on how to measure liquids and weights accurately. There is some skill involved with accurate measurement in the austere laboratory.

5. You should not meet your microscope for the first time when you need to process a specimen. The microscope is a delicate instrument that requires practice to use properly to achieve results and prevent damage. Consider taking a course/picking up a book on the use of the microscope and spending some time learning how to use it correctly.

6. If you are preparing laboratory water and reagents, use the utmost care to protect them from contamination. Only take what you need for the test and never replace excess into the storage container. Use clean instruments when dispensing from the storage container. Protect the stability of the reagent and discard if you are suspect as to its quality.

7. Take the time to maintain your laboratory equipment. Do not be afraid to improvise or build your own laboratory equipment and make your own reagents. Experiment to achieve success. Look at old publications on how laboratory equipment was improvised/homemade in the past and replicate.

8. Record your results in order to provide the opportunity to reflect on your successes and failures and notice trends that could be indicative of laboratory error.

9. Consider developing a relationship with a distant laboratory. Understand what capabilities they have that you do not and understand how to package specimens for transport to them for testing. Poorly packaged/prepared specimens do not survive transport in the austere environment and will become useless when they arrive at the receiving laboratory.

References to Consider.

Laboratory medicine is complex and it is outside the scope of this book to cover all techniques and procedures that would be valuable in the austere laboratory. Likewise, if not frequently practices it is easy to forget procedures and reagent formulations. As such, it is suggested that the remote / austere survival laboratory consider holding the following references in their collection:

1. *World Health Organization – Manual of Basic Techniques for a Health Laboratory – 2nd Edition, 2003*. This is an excellent starting point for reading/preparing your survival laboratory.

2. *World Health Organization – Basic Laboratory Procedures in Clinical Bacteriology – 2nd Edition, 2003*.

3. *World Health Organization, Regional Office for the Eastern Mediterranean – Production of Basic Diagnostic Laboratory Reagents – 1995.* Although the Manual of Basic Techniques for a Health Laboratory as the preparation of reagents as an annex, this stand-alone manual offers some other options when the required chemicals are not universally available.

4. *World Health Organization, Regional Office for South-East Asia - The Microscope: A Practical Guide – 1999.*

5. *A Medical Laboratory for Developing Counties – 1973.* – Maurice King (Oxford University Press)

6. *World Health Organization – Basic Malaria Microscopy: Part 1, Learner's Guide – 2010.*

7. *World Health Organization – Bench Aids for the Diagnosis of Malarial Infections – 2000.*

The Examination of Urine:

Collecting urine.

Urine should be collected in a wide-mouth, clean and dry container. At least 20 mL should be collected. There are several types of urine specimens.

1. First wake. Provides the most concentrated sample and likely easiest to work with in the survival laboratory.

2. Random. Taken at any time of the day. Good to detect kidney infections.

3. Midstream. The patient starts to urinate, stops, then starts again and takes the sample. This provides a clean-catch with the first urine being used as a urethral flush.

4. Terminal. The patient urinates and then stops just before they are finished. They then void the final contents of their bladder into the specimen cup.

5. Catheter. In the unable or unconscious, a catheter (either indwelling or in-and-out) can be used to collect urine samples. This is often the best technique when you are going to culture the urine for bacterial growth, as the procedure is sterile and normally provided specimens are often contaminated with environmental/skin pathogens when being provided.

6. Infant. Collecting urine from an infant can be tricky. Although there are commercial adhesive bags that are placed over the infant's genitals and then filled when the infant voids over the next 1-3 hours, these are not necessary. A Ziploc bag (or colostomy bag) can be used as they are clean if not sterile. The trick will be securing it to the infant to prevent leakage. An infant can also be catheterized if required and the clinician has the requisite skillset and equipment.

If urine is going to be examined immediately there is no requirement to add any preservative agents.

The point-of-care testing approach to urine testing.

Urine chemistry:

Urine is easily tested with a commercially available multi-function test strips (dip sticks). These can test for the presence of protein, glucose, ketones, nitrates, red blood cells, and white blood cells. The test strip is dipped in a specimen of clean catch urine (i.e. urination begins in the toilet, stop, then start again into the specimen container, stop, and continue into the toilet) and panels containing the test reagents change color depending on the presence and concentrations of the substance being tested for. The color changes are compared to a table supplied with the strips. The strips can be used to diagnose urinary infections, toxemia in pregnancy, dehydration, diabetes (outside pregnancy), and renal stones/colic.

Urinalysis reagent strips commonly test for the following:

- Leukocytes
- Nitrite
- Urobilinogen
- Bilirubin
- Ketones
- Protein
- pH
- Specific gravity
- Glucose
- Blood

Cost is approximately US $20 per 100 strips.

If you have the requirement to get the most "bang for the buck" out of your test strips that you can, individual pads (and therefore tests) can also be cut off the stick. This allows you only to dip the urine for the test you require as opposed to all ten tests in each drip. To do this you should ensure that you use a moisture-free technique and use care when placing each pad into a labeled air and lightproof container so that you do not mix up the tests. You should also indicate on the label the expiry date and manufacture of the test strips so you can ensure that you use the correct color chart for reading. When required for use, the pad can be held with a pair of forceps.

Technique is important and the user can produce false results. For example, leukocytes precipitate at the bottom of the container and may not be detected if the sample is not properly mixed. If an excess of urine remains on the strip after it has been removed from the test sample, this may cause the reagents to leak from the pads onto adjacent pads resulting in mixing and distortion of the colors.

Leukocytes are white blood cells. They should not be in the urine. If you have positive leukocytes in the urine you should consider if the patient has an infection.

Nitrites in urine indicate a urinary tract infection. In the early stages of a urinary tract infection the dipstick may show negative, but as the infection develops it will convert to positive.

The pH tells you how much acid is in the urine. Alkaline urine (pH 7.8 or higher) can be indicative of a urinary tract infection. This is not fool proof, as some diets (vegetarians) will also force a higher pH result. Acidic pH (4.5 – 5.5) is sometimes seen in diabetes, muscular fatigue and acidosis.

Specific gravity is a measure of the concentration of the urine. If dehydrated the urine is “dense” and the specific gravity will be higher than 1.025. If overhydrated the urine will be “thin” and the specific gravity will be lower than 1.005.

Ketones are positive with severe diabetes, dehydration, malnutrition, sometimes in severe diarrhea and occasionally in someone who has been exercising heavily.

Protein in urine is large amounts can indicate a urinary tract infection, kidney problems, toxemia in pregnancy or chronic malaria. It is normal in children in small amounts and can also be positive if blood is in the urine or the person has consumed large doses of vitamin C (ascorbic acid).

Urobilinogen should be negative or trace if a normal test. If positive you should consider malaria (especially if they have a fever) problems with spleen or liver or sickle cell anemia.

Bilirubin in the urine is often indicative of a liver disease. Consider hepatitis.

Glucose tells you if there is sugar in the urine. This could be normal (say the person just ate a large sugary meal) or it could indicate diabetes. It can also be positive in pregnant women and falsely positive if the person is taking tetracycline.

Blood is indicative of a urinary tract infection, kidney stones, blunt kidney trauma or parasitic illness. It is likely positive if a female is menstruating and is tested.

Pregnancy Tests:

The ability to accurately diagnose pregnancy with may be important both for psychological reasons and for practical reasons. Currently available pregnancy test kits will test urine for the presence of the hormone Human chorionic gonadotrophin (hCG). They require only a small amount of urine and are accurate from seven days from conception. The tests available in common grocery stores are nearly as sensitive as a laboratory test, in fact many emergency departments rely on this type for their rapid tests. These tests are inexpensive and widely available. Follow directions included with packaging.

The chemistry-based/physical examination laboratory method of urine testing.

Visual inspection of urine:

Much can be learned from the visual examination of urine. With the urine in clean glassware and held against a white background under good lighting you may notice:

1. The urine is dark yellow. The darker the color the more concentrated. Normal urine should be clear and straw yellow in color.

2.The urine is cloudy. This is likely due to the presence of blood cells/excess salts.

3. The urine is deep yellow or even brown. This could indicate pigments from bile being present.

Testing the pH of urine:

Place the urine in a test tube and drip with a strip of wide-scale pH paper. Place a few drops of urine onto the pH paper. Read the pH paper using the chart on the container. Normal urine has a pH of 5-7. If the results are higher or lower, re-test using pH paper that is more specific and limited to the range of initial detection.

Testing for glucose in the urine:

Glucose is a reducing substance and will change copper sulfate from blue to copper oxide that is red. It should be noted that lactose would do the same thing, as lactose if sometimes present in the urine of pregnant women.

1. Place 5ml of Benedict solution in a test tube.

2. Add eight drops of urine and mix.

3. Boil over flame for two minutes or in a can of boiling water (bath technique) for five minutes. Allow to cool to room temperature.

4. Look for color change from blue to red, which indicates glucose is present.

Testing for protein in the urine:

In the absence of a dipstick test, you can take urine and place it in a test tube along with a few chips of fine broken glass (to prevent splattering) and boil. If the urine looks like the white of an egg (gel formation) it contains a large amount of protein.

Another option is make a solution of 500 mg of sulfosalicylic acid to 15 ml of water. Add a drop of this solution to test tube containing your urine specimen and shake it. Check for cloudiness against a plain background in a well-lit area. If cloudy then protein is present.

Testing for bilirubin in the urine:

In the absence of a dipstick test you can place urine into a test tube or small glass bottle and shake vigorously. At the same time, take a known normal urine sample and do the same thing in another test tube. Compare the two. If bile is present in the sample you will see foam in the urine that is yellow. It looks like soapsuds. In the normal sample, you should get little foam or a white/clear foam.

Testing for ketones in the urine:

Nitroprusside + ketones = purple.

1. Place some nitroprusside crystals into the bottom of a test tube. Add 5 ml of distilled water and shake well. Most, but not all of the crystals will dissolve as the solution is saturated.

2. Place 10 ml of urine in another test tube. Add four drops of acetic acid to the urine then 10 drops of the nitroprusside solution you just made in the previous step.

3. Take a pipet with 1 ml (20 drops) of ammonia solution. Add slowly along the side of the test tube in order to get the ammonia to rest "float" on the top of the urine solution.

4. Wait five minutes. If color change is going to be seen it will occur before five minutes. If no color change occurs, there are no ketones. If you get a pink ring on the top of the urine (where you added the ammonia) then you have + ketones, if you get a red ring on the top of the urine then you have ++ ketones and if you have a purple rink on the top of the urine you have +++ ketones.

Testing the specific gravity of urine:

A urinometer is a glass float containing a weight, and a stem which can be used repeatedly in testing urine for specific gravity. Place the urine sample in a tall cylinder and place the urinometer in the cylinder and allow it to stop moving. Read the number on the stem where the urine meniscus crosses it. This is the specific gravity. If there is protein or glucose in the urine the specific gravity will be falsely high using this method.

Microscopic examination of the urine.

Abnormal contents that may exist in a urine sample may be seen under a microscope after the sample has been centrifuged. This includes seeing leukocytes, many erythrocytes, parasitic trophozoites, ova, casts, crystals, fungi or bacteria.

1. A midstream sample is taken in a clean, dry container. Ideally it should be examined promptly, however if this is not possible it can be preserved with 8-10 drops of a 10% formaldehyde solution for every 300 ml of urine. Note that added formaldehyde may prevent other urine testing to occur and the sample will be spoiled for anything other than microscopic examination.

2. Place 10 ml into a centrifuge tube and spin for five minutes at medium (2000g) speed.

3. Without stirring the sample pour off the supernatant liquid. This liquid may be required for other testing.

4. Add distilled water to the deposit remaining and shake. Transfer one drop onto a microscope slide and coverslip. Label the slide with the patient's name.

5. Using the 10x objective scan the slide looking for ova. Then move to 40x and examine for the other aforementioned abnormal contents. It may be helpful to have a bench aid that provides high-quality pictures of each of the abnormal microscopic finding in so that you can compare what you are seeing to a known abnormality.

Microscopic blood (erythrocytes) in the urine can be indicative of a vaginal tract infection, glomerulonephritis, urethritis, cystitis, a parasitic infection (like schistosomiasis) or a tumor. It is normal for a few erythrocytes (0-10 per field) to be present and you will likely see a quantity of them if the sample is from a woman who is having her menstrual period.

A quantity of leukocytes may be indicative of urinary tract infection. This is especially true if seen in clumps of degenerated cells.

Renal cells are medium-sized ovals with a distinct, shiny nucleus. They are often found when protein is also present in the urine.

Casts are long cylindrical objects that almost take up the whole field. They need to be differentiated by type to have diagnostic value. Some are normal (hyaline, epithelial, and granular casts for instance) while other can indicate kidney disease (blood casts and fatty casts), kidney infections (pus casts). Again high quality imagines from a bench aid can be very helpful in trying to figure out what you are seeing.

Examination of the urine for bacteria.
See the section below entitled: The Examination of Bacteria, Viruses and Fungi.

Examination of the urine for schistosomes.
See the section below entitled: The Examination of Parasites.

The Examination of/for Blood:

Blood can be examined for the physical characteristics of the blood cells and the chemistry contained within the blood.

The point-of-care testing approach to blood testing.

Blood glucose testing:

The blood glucose meter (glucometer) is commercially available at almost every pharmacy. These can be used to diagnose diabetes (in a survival situation); both general and during pregnancy, also it can detect low or high blood sugars in other severe illnesses. A finger or toe is pricked and a drop of capillary blood is collected onto a test strip that is placed into the meter. An electronic glucometer can be had initially for a small investment, but as a general rule the most inexpensive meters require the most expensive consumable strips. The survival medicine clinician must weigh their cost, necessary reliance upon batteries, and consumable test strips with the information they provide.

Examining feces for the presence of blood:

If you want to know if you patient has gastrointestinal blood loss then you can examine the feces for blood. This can help diagnose anemia and differentiate bloody diarrhea from non-bloody diarrhea (which is important as they are treated differently). This test may have a false positive if the person has eaten raw/rare- cooked meat, taken iron supplements, consumed cucumber, cauliflower or horseradish,

or vitamin C and citrus fruits in the few days leading up to the test. This test is best done with these items removed from the diet for a number of days before the test.

A guaiac fecal occult blood test card is available as a point-of-care test. Feces is applied to a thick piece of paper attached to a thin film coated with guaiac and then on the other size of the card one or two drops of hydrogen peroxide is applied. It is observed for a rapid blue color change that indicates blood in the stool.

fecal occult blood test package

Blood hemoglobin level:

The deficiency of hemoglobin is known as anemia. The testing of hemoglobin at point-of-care is simple given the use of hemoglobin paper. The patient vigorously rubs their earlobe and it is lanced and released. A drop of blood is allowed to form. This drop (but not the earlobe proper) is touched to the hemoglobin paper, near the edge. The paper absorbs the drop of blood and will dry. The dry color on the paper is then compared to the color reference chart to establish the approximant hemoglobin level.

Testing the blood for blood urea nitrogen:

A blood urea nitrogen (BUN) test measures the amount of nitrogen in your blood. Nitrogen comes from the waste product urea, which is made when protein is broken down in your body. Urea is made in the liver and passed out of your body in the urine. A BUN test is done to see how well your kidneys are working. A point-of-care testing solution, called Azostix Reagent Strips are useful to determine the BUN level. A drop of blood is placed on the strip and the strip is read at 60 seconds on a chart. These test strips are approximately US $35.00 for 25 tests.

The i-STAT handheld blood analyzer.

The ultimate point-of-care laboratory testing capability comes in the form of the i-STAT handheld blood analyzer from Abbott. This machine has latterly changed the way medicine looks at point-of-care testing. A handheld blood analyzer, you select one of a number of test cartridges and put a sample of blood in the cartridge. The cartridge is then loaded into the i-STAT and a few minutes later you have your results. Pretty remarkable science for use in the austere environment because it is really a handheld laboratory that allows you to do all sorts of blood tests unthinkable in remote situations.

The good: You can run full chemistry and electrolyte panels (sodium, potassium, chloride, TCO_2, Anion Gap, Ionized Calcium, Glucose, Urea Nitrogen, Creatinine, Lactate), hematology panels (Hematocrit and Hemoglobin), blood gases, PT/INR, pregnancy and cardiac panels (cTnl, CK-MB, BNP). Abbott is constantly coming out with other cartridges also. The machine is reliable, somewhat environmentally rugged, easy to use, fast and requires small volumes of blood to conduct the analysis (2-3 drops). The support from Abbott is also good, even when telephoning from the middle of Africa.

The bad: It is expensive, like USD $6500 - $8000 new. It requires regular access power to recharge. The cartridges are expensive (USD $7.50 to 23.50 a test). The cartridges cannot be used once they time expire, as the analyzer will not read them.

Here is the remote, austere, survival medicine problem – it requires a software update every six months. If it does not get the CLEW system software update (generally in May and November) it stops working and your cherished handheld laboratory becomes a brick of unusable electronics. Now, the software is downloadable from Abbott with some ease, but this requires a computer and access to a sable Internet

connection. You get a warning (CLEW Expiring, Update Required) 15-days before the software expires and after it expires you get the dreaded "Invalid or Expired CLEW Code 12" error. You also should run an Electronic Simulator test on the i-STAT after you do the system software update, which just adds to the misery of the update process. In fairness to Abbott, the update is required to re-establish the standardization values and incorporate refinements to the internal quality monitoring system keeping it CLEW compliant. It also allows for new cartridges to be added to the handheld analyzer that have come on the market since the last update. This still does not help you when you are sitting in rural Vietnam at 2 am with a patient who has been hit by a truck and you get a CLEW 12 error when you are trying to run a blood gas. Finally, the manufacture states that the cartridges must be stored refrigerated and used within two months when brought to room temperature, although there is some published literature (such as, Clinical Chemistry 50, No. 3, 2004, Stability of i-Stat EC6 Cartridges: Effect of Storage Temperature on Shelf Life) which suggests that temperature control may not be as important as the manufacturer suggests. There is also some gray-literature put out by the US military that indicates the same. This lends itself to a risk-benefit analysis which would suggest that using it outside the temperature control parameters likely is fine in the remote/austere/disaster situation.

The warning: You will see the older i-Stat model 200 handheld analyzers for sale on the Internet. This device is no longer supported by Abbott as of December 2013 and is unusable. Second to this, if you see one on the Internet for sale or are going to "acquire one" from a local hospital be aware that Abbott will disable the machine if reported stolen when doing your next required software update.

The bottom line: Good if you have the cash and are working in an austere/remote situation that allows you to update the machine every six months. Not so useful if you are funds limited or you expect to be in a long-haul survival medicine/grid-down situation.

The laboratory approach to blood testing.

Examining feces for blood:

The laboratory variation of the guaiac fecal occult blood test card suffers from the same false positive results from certain dietary items. See above for more information.

1. Take a pea-size piece of feces and smear on a piece of filter paper with an instrument.

2. Take a Hematest Reagent Tablet (at least 1/4 or more) and place top of the stool. Add clean water in a manner so it soaks the tablet and runs down into the stool. Push the tablet around the stool to maximize stool to tablet exposure.

3. Look for a bluish color within the first two minutes. Ignore any color change after two minutes.

Blood Counts:

There is no easy way to do blood counts without some basic equipment. You need a microscope and a graded slide called a counting chamber or hemocytometer. The ruled counting chamber (most commonly known as an improved Neubauer counting chamber) is a microscope slide that has a sink in

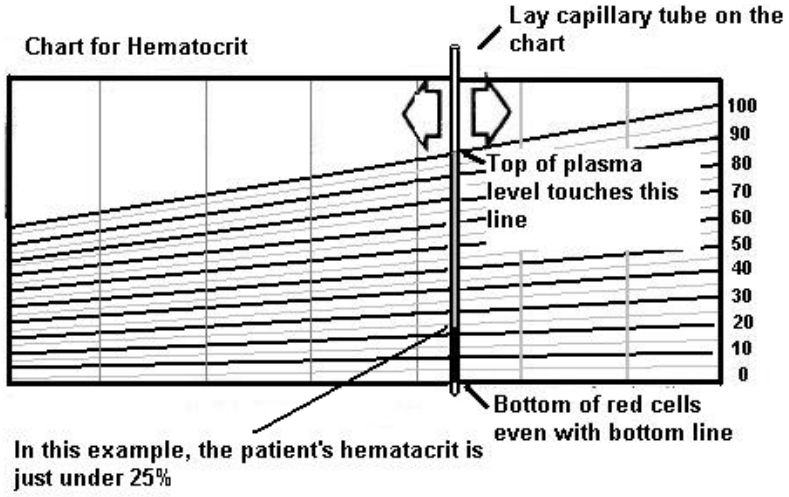
the middle and a very small grid etched onto its surface. Using a standardized technique a drop of diluted blood is placed on the slide. Now using the microscope 10x objective and 10x eyepiece the number of different types of blood cells in a square on the slide is counted, this is then repeated several times and then averaged. This technique will give you a white cell (leukocyte) count that is useful in detecting infections. In some infections the total numbers of white blood cells in elevated (such as infectious mononucleouis and most bacterial infections) and in others it is decreased (such as typhoid fever).

The improved Neubauer counting chamber can be found frequently on auction sites such as e-Bay at a price of $20-30 USD. The hemocytometer frequently comes as a kit with two graduated pipettes, the hemocytometer itself, the cover slip, and a set of instructions. The basic procedure is to dilute the sample to a given ratio and place that sample on the tiny grid etched into the glass of the hemocytometer. A cover slip is a precise set distance from the bottom of the slide creating a known volume for each of the squares. The sample and the counting chamber are then viewed through the microscope. The idea is to count how many cells appear in the squares. Several squares are counted and taken into account to average out the number. After some quick calculations (which can be found on the Internet or in the 2003 World Health Organization publication entitled "Basic Laboratory Techniques") the numbers are reported as the limber of leukocytes in 10^9/L.

Measuring hematocrit:

The hematocrit test consists essentially of drawing a blood sample, adding a small amount of anticoagulant to prevent clotting (such as sodium citrate or heparin), and placing a sample in a very tiny glass tube called a capillary tube. The capillary tube end is sealed with a clay-like substance, centrifuged for 5 minutes at 2000 rpm. The packed red blood cell volume is determined by comparison with a standard scale on a micro hematocrit reader.

NOTE: The picture below is for illustration purposes only. DO NOT attempt to use it as the hematocrit scale!



Measuring bleeding time:

In order to ensure that the patient has the ability to clot pre-surgery and to detect some hematologic disorders, the time from commencement of bleeding to clotting can be tested. Although mostly done by blood chemistry in modern laboratories, a direct measurement (Duke method) has been used for years in the developing world.

1. Clean the earlobe with alcohol. Do not rub or massage. Allow to dry.

2. Puncture the earlobe with a sterile lancet. The blood should flow without the need to squeeze or milk the earlobe. Start the stopwatch.

3. In 30 seconds collect a drop of blood (#1) on the corner of a piece of filter paper. Do not touch the skin to the paper.

4. At 60 seconds collect a drop of blood (#2) in the same manner but a little further along the paper.

5. Continue this process with one drop of blood collected every 30 seconds. The drops will become smaller as time progresses.

6. When no more blood appears (drops on the paper) stop the stopwatch. The bleeding time is reported as the number of drops on the paper x 30 seconds. The normal range for someone who is has normal clotting is 1-5 minutes.

Direct examination of the blood:

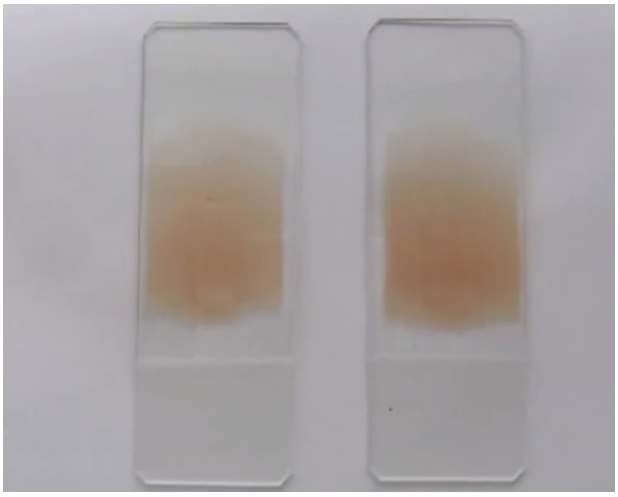
The most advance thing one can do in the field laboratory is the direct examination of the blood with the microscope. It is a skill that requires practice to become proficient, but once achieved, it provides notable diagnostic value. It also helps to have a reference book so you can compare what you are seeing to a known reference.

The blood is examined by making a thin film on a microscope slide. The goal is to take one drop of blood and have a film so thin that there is only one layer of cells in which to observe. The thin blood film is then stained to enhance the visibility of the components.

1. Take blood from the third of forth finger. Do no use the ear, an infected finger, the index finger or thumb. Strike with a sterile lancet and then let the blood flow freely. Collect a drop of blood 4 mm in diameter by touching it lightly to one side of the perfectly clean microscope slide. Take first samples for erythocyte and leukocyte analysis. You must make the film within 1-2 hours of collection. If not you need to preserve the blood in 10% solution of EDTA dipotassium salt. Do not use other anticoagulants (e.g. heparin) or it will alter how the leukocytes and thrombocytes look under the microscope.

2. Place the microscope slide between your thumb and finger on your non-dominant hand. In your other hand place the spreader (or another clean glass slide) on the slide out of contact with the blood. Move the spreader back until it touches the blood and wait a moment for the blood to be drawn across the edge of the spreader. Push the spreader to the end of the slide with a smooth movement. All blood

should be used up before you reach the end of the slide. At no time will you ever push the spreader OVER the drop of blood on the slide. This process takes practice. Eventually you will become proficient and have a slide that is smooth, not too thick, without lines in the film and is not too long. If you find that the film contains holes in it, use a clean slide as oil was deposited on the slide before collection. If you cannot make a thin smear, you cannot move on and will lead to you reporting incorrect information on microscopic examination.



3. In dry climates the slide can be left to air-dry. In wet climates wave the slide rapidly about 5 cm away from an alcohol burner. Never expose the slide directly to the flame. Protect the slide from flies. Note the patients name on the slide.

4. You need to lock the blood film to the slide. This is called fixing and is done by exposing the slide to methanol for 2-3 minutes before staining.

5. If you are going to examine the slide for leukocytes you will stain the slide with the May-Grunwald stain. Dilute the May-Grunwald stain 1 in 2 with equal parts of stain and buffered water. Place the slide in the stain for 5 minutes and then tip the slide off to drain excess stain. If you are also going to examine the slide for parasites you will need to also stain the slide with Giemsa stain. Dilute the Giemsa stain 1 in 10 with equal parts of stain and buffered water. Do not shake as the stain will precipitate. Note that neither of the stain dilutions do not keep well and will only last 24 hours. Place the slide post-staining with the May-Grunwald stain in the Giemsa stain for 10 minutes. This is not a hard and fast time and will need to be adjusted based on the quality of your stain. Wash the slide off with buffered water. Do not tip the stain off, as you will leave deposits of the stain on the slide. Leave clean water on the slide for 2-3 minutes to differentiate the film. Ideally the water will have a pH of 6.8-7.0. If not times will be increased/decreased. Tip the water off and place in a rack to dry.

6. Examine the slide with the x40 objective on your microscope. You will be able to see (if present) erythrocytes (including those with Howell-Jolly bodies, Cabot rings, basophilic stippling, normoblasts, reticulocytes), target cells, sickle cells, microcytes, macrocytes, schistocytes, spherocytes, elliptocytes, anisocytosis, poikilocytes. Under the 100x oil-immersion objective you will see leukocytes, including polymorphonuclear neutrophils, eosinophils and basophils as well as lymphocytes, monocytes and other less common cells. It takes time and experience to differentiate all of these indices and a good bench reference with good pictures is most helpful.

The scope of what to look for and what it means is beyond this book, but some generalizations are as follows:

Target cells	Thalassemia, vitamin B6 deficiency, liver disease, sickle-cell anemia and iron-deficiency anemia.
Sickle cells	Sickle-cell anemia.
Microcytes	Iron-deficiency anemia, sideroblastic anemia, thalassemia.
Macrocytes	Macrocytic anemia caused by folic acid deficiency and vitamin B12 deficiency. Iron-deficiency anemia and some liver diseases.
Schistocytes	Hemolytic anemia, sickle-cell anemia and thalassemia.
Spherocytes	Hemolytic anemia.
Elliptocytes	Rare. Iron-deficiency anemia, pernicious anemia, sickle-cell anemia, thalassemia and myelofibrosis.
Anisocytosis	Many types of anemia.
Poikilocytes	Severe anemia and myelofibrosis.
Howell-Jolly brodies	Post-splenectomy, hemolytic and magaloblastic anemia's.
Cabot rings	Severe anemia. Caution can look like malaria parasites.
Basophilic stippling	Vitamin deficiency, thalassemia and lead poisoning
Normoblasts	Severe anemia, severe bacterial infections, leukemia and other cancers.

7. Leukocytes are examined under 100x oil-immersion objective for the proportion of each type of leukocytes. This is known as the leukocyte type number fraction and is of diagnostic relevance. 100 leukocytes are counted and the number each type is recorded. These proportions are reported as a decimal fraction where the total of all fractions equals 1.0. For example:

Neutophills	0.55
Lymphocytes	0.26
Eosinophils	0.12
Monocytes	0.05
Basophils	0.02

Tables for normal leukocyte type number fractions can be found in any good reference manual. Note that the fractions change by age group of the patient and should be referenced appropriately.

Neutrophillia is the increased fraction of neutrophils (above 0.65) and is indicative of infections.

Nutropenia is the decreased fraction of neutrophils. It is indicative of some infections (such as sepsis).

Eosinophilia is the increased fraction of eosinophils (over 0.05) and is suggestive of a tissue localized parasitic infection like schistosomiasis, filariasis, hookworm or ascariasis). It can also be caused by allergies.

Lympocytosis is an increase faction of lymphocytes (over 0.35 in adults and 0.45 in children). It is seen in virus infections, malaria and tuberculosis.

Lymphopenia is a decreased fraction of lymphocytes and is seen in AIDS.

Moncytosis is an increase fraction of monocytes (above 0.06). It occurs with bacterial infections and some parasitic infections (malaria, visceral leishmanasis).

There is also some morphology that you may detect on observation. The presence of monocytes with a brown-black mass in the cytoplasm is often indicative of malaria. Hyper-segmented polymorphonuclear neutrophils are often seen in patients with macrocytic anemia caused by B12 or folic acid deficiency. Atypical lymphocytes can been seen in vital infections (most notably mononucleosis, whooping cough and measles), AIDS, severe anemia and tuberculosis.

8. Count the thrombocytes and come up with a thromocyte number concentration. This is done under the 100x oil-immersion objective on the stained slide. Count the number of thrombocytes in 20 fields and average. Normal ranges by age group are found in common medical references.

The Examination of Bacteria, Viruses and Fungi:

The point-of-care testing approach to bacteria & virus testing.

There are several commercially available kits for testing for bacterial. When searching for them on the Internet it is helpful to use the search term "CILA waived". This will help you find test kits that are designed to be used outside of the conventional laboratory.

Strep Throat: A test called rapid strep (or rapid antigen detection test) is used to qualitatively detect Group A Streptococcus antigen from a throat swab. It aids in the diagnosis strep throat. Not detecting and treating a strep throat infection can lead to several health problems down the road. Strep throat is a common condition, especially in children. The test kits are accurate (95%), easy to use and provide much quicker results then trying to culture the swab. The cost is approximately US $45 for 25 tests.

Mononucleosis: Infectious mononucleosis is caused by Epstein-Barr virus, which is a member of the *Herpesviridae* family and one of the most common human viruses. It is generally a self-limited disease presenting with fever, sore throat and fatigue, and only supportive treatment is normally required. Testing is often advantageous to rule out more sinister causes of the non-specific symptoms and to rule out the need for antibiotics.

The point-of-care test kit (often called a Mono-spot test) takes a few drops of blood and produces results within 5 minutes. It is an accurate test at 99%.

Influenza: A rapid influenza point of care test is available. It qualitatively detect Influenza A + B from a nasal swab specimens to aid in the diagnosis of influenza versus the common cold. Knowing that someone is influenza positive, especially within the first 48 hours can aid in decisions with respect to treatment and quarantine. The one drawback to this test is that they are costly, approximately US $14 a test.

Helicobacter pylori: *H. pylori*, is a spiral-shaped bacteria that grow in the digestive tract and have a tendency to attack the stomach lining. They are thought to cause ulcers and knowing the bacteria is present allows you to target it with the appropriate antibiotic therapy, as opposed to managing the ulcer

symptomatically and hoping it will clear up on its own. The rapid test kits come in two models. One detects *H. pylori* in the blood and the other in the stool.

Rotavirus/Adenovirus: Rotaviruses are the most common cause of pediatric gastroenteritis and diarrhea. Rotavirus A accounts for over 90% of infection in humans. Worldwide over 500,000 children under the age of 5 die from rotavirus infection and over 2,000,000 become severely ill each year, mostly in developing countries. Rotavirus accounts for up to 50% of hospitalization in infants and children with severe diarrhea. The fecal-oral route transmits this virus. A rapid test kit is available that will detect Rotaviruses in a diluted stool sample. There is also a duel rapid test kit that will detect Rotaviruses and the Adenovirus. This virus is the second most common cause of viral gastroenteritis in children. In addition to diarrhea (which can last between 9 and 12 days and is associated with fever and vomiting), Adenovirus may also cause respiratory diseases, conjunctivitis and cystitis depending on the serotype. Knowing that the cause of diarrhea is viral versus bacterial or parasitic will aid in selecting the correct treatment.

Legionella: *Legionella pneumophila* is gram-negative bacillus. It is a common cause of community-acquired and nosocomial pneumonia. Legionellaire's disease can be acquired by the inhalation of aerosols associated with air handing systems, respiratory therapy equipment, and whirlpool baths. The elderly are seen as most susceptible to the infection, although children and neonates are also affected. About 5% to 39% of people with legionnaire's disease die. *Legionella pneumophila* serogroup I antigen has been detected in urine during the acute phase of the disease. There is a rapid point-of-care test kit that will detect the antigen in the urine.

Salmonella: Typhoid fever is a serious illness caused by the bacterium *Salmonella Typhi*. It is common in developing countries where it affects about 12.5 million persons annually. The infection is acquired typically by ingestion. A massive bacteremia follows, heralding the onset of the clinical symptoms. Traditional laboratory techniques for the isolation of the bacilli are complex and do not lend themselves to an austere / survival laboratory. As such the rapid point-of-care test care is useful as it will detect *Salmonella Typhi* in 1-20 minutes from either a serum or stool sample.

Sexually Transmitted Infections: Point-of-care test kits exist for the detection of Gonorrhea, Syphilis and Chlamydia. These kits are useful as they save the effort, complexity and long hours of culturing the collected specimen.

The Chlamydia rapid test detects the chlamydia trachomatis antigen. It is often specific to gender with one test kit for endocervical (female) swabs and one for endourethral (male) swabs.

The Gonorrhea rapid test detects the bacterium *Neisseria gonorrhoeae* in urine or urogenital swab samples.

The Syphilis rapid test detects *Treponema pallidum* antibodies in whole blood, serum and plasma samples. It is also useful for screening of blood donors and blood products. This test is sometimes referred to as a rapid plasma regain or RPR test.

HIV: A rapid, point of care HIV test kit exists. For example, one of the commonly known tests in the US is from a company called OraQuick and is available in drug stores. This oral swab will determine HIV status within 20 minutes by detecting the antibodies for HIV that is found on the gums. It is useful for use with blood transfusion/blood product screening. The cost is US $40.00 per test.

Hepatitis: Rapid test kits for Hepatitis B and Hepatitis C exists on the market (for example OraQuick HCV). Separate tests (for Hepatitis B and C) these test will provide results from a blood sample (with greater than 98% accuracy) in 15-20 minutes. The Hepatitis B kits are often marketed as HBsAg kits and the Hepatitis C kits are often marketed as HCV kits. They are most useful for use with blood transfusion/blood product screening.

The laboratory testing approach to bacteria testing.

Gram Staining:

This is a technique for approximate identification of bacteria in urine, pus, sputum, cerebral spinal fluid (CSF), and from bacterial cultures. Although not highly accurate in species identification, combined with knowledge of the clinical situation, it enables a good guess to be made for the appropriate antibiotic. It requires a microscope and also several chemical solutions.

The Gram stain is the most widely used staining procedure in bacteriology. It is called a differential stain since it differentiates between gram-positive and gram-negative bacteria. Bacteria that stain purple with the Gram staining procedure are called gram-positive; those that stain pink are said to be gram-negative. Gram-positive and gram-negative bacteria stain differently because of differences in the structure of their cell walls.

The gram staining procedure involves four basic steps:

1. The bacteria are first stained with the basic dye, crystal violet. Both gram-positive and gram-negative bacteria become directly stained and appear purple after this step.

2. The bacteria are then treated with an iodine solution. This allows the stain to be retained well. Both gram-positive and gram-negative bacteria remain purple after this step.

3. Decoloriser is then added. This is the differential step. Gram-positive bacteria retain the crystal violet-iodine complex while gram-negative are decolorized.

4. Finally, the counterstain safranin is applied. Since the gram-positive bacteria are already stained purple they are not affected by the counterstain. Gram-negative bacteria that are now colorless become directly stained by the safranin. Thus, gram-positive appear purple and gram-negative appear pink.

It is important to note that gram-positivity (the ability to retain the purple crystal violet-iodine complex) is not an all-or-nothing phenomenon but a matter of degree. There are several factors that could result in a gram-positive organism staining gram-negatively:

1. The method and techniques used. Overheating during heat fixation, over decolorisation with alcohol, and even too much washing with water between steps may result in gram-positive bacteria losing the crystal violet-iodine complex.

2. The age of the culture. Cultures more than 24 hours old may lose their ability to retain the crystal violet-iodine complex.

3. The organism itself. Some gram-positive bacteria are more able to retain the crystal violet-iodine complex than others.

Therefore, one must use very precise techniques in gram staining and interpret the results with discretion.

Procedure

1. Heat-fix a smear of a mixture of the bacterium as follows:

a. Using the dropper bottle of distilled water place a small drop of water on a clean slide by touching the dropper to the slide.

b. Ideally, should this sample be from a wound, it would be cultured on an agar plate, and then a sample colony of cells would be transferred to the slide with a sterilized wire loop. Failing that, take a small sample from the exudates of the wound directly with the sterilized wire loop.

c. Using the loop spread the mixture over the entire slide to form a thin film.

d. Allow this thin suspension to completely air dry.

e. Pass the slide (film-side up) through the flame of the Bunsen burner 3 or 4 times to heat-fix the sample. Never allow any portion of the slide to become hot to the touch.

2. Flood the slide with crystal violet (solution of 0.3% crystal violet in 0.8% ammonium oxalate) and let stand for one minute and then gently wash off with water. Shake off the excess water but do not blot dry between steps.

3. Stain with iodine solution (0.33% iodine + 0.66% potassium iodide in water) for one minute then gently wash with water.

4. Decolorize by adding gram decolouriser (ethanol/acetone solution 1:1) drop by drop until the purple stops flowing then wash immediately with water.

5. Stain with safranin (0.25% safranin, aqueous solution) for one minute then wash with water.

6. Blot or air dry, and observe using oil immersion lens on your microscope at 1000x magnification.

You may call the cells that you see either gram-positive or gram-negative.

Further classify bacteria by their shape and pattern.

Cocci (singular: Coccus) are generally spherical though with some variation from this theme (i.e., elongation or flattening on one side).

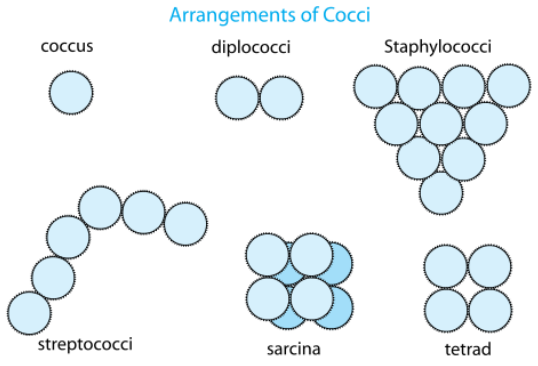
1) Diplococci: Cocci that remain in pairs after they divide

2) Streptococci: Cocci that fail to separate after they divide but instead remain in chains of cells.

3) Tetrad: Cocci that fail to separate after they divide but instead remain in groups of four forming squares.

4) Sarcinae: Cocci that fail to separate after they divide but instead remain in groups of eight forming cubes.

5) Staphylococci: Cocci that fail to separate after they divide but instead remain in amorphous sheets or clumps.



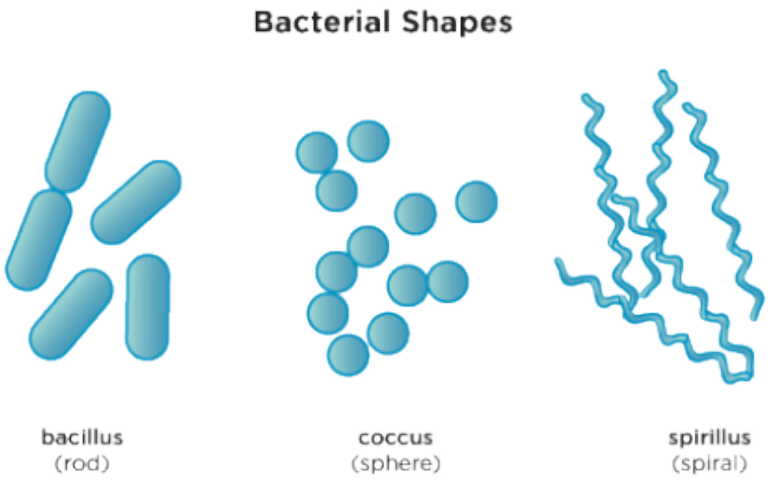
Types of cocci. wikipedia

Bacilli (singular: Bacillus) are rods or variations on rod-shaped bacteria: tapered rod, staff, cigar, oval, or curve shaped. Basically, *bacilli* are longer than they are wide and lack extreme curvature.

1) Diplobacilli: Paired rods that remain in pairs after they divide.

2) Streptobacilli: Rods that fail to separate after they divide but instead remain in chains of cells.

3) Coccobacilli: A short rod that nearly looks like cocci.



Wikimedia commons

Additional bacterial shapes include:

1) Budding
2) Commas
3) Corkscrews
4) Helical
5) Mycelium
6) Spirillum (rigid, wavy spirals)
7) Spirochetes (flexible spirals)
8) Squares
9) Stars
10) Etc.

Adding the shape and arrangement of the bacteria to the gram-negative or positive status can help you to select the proper antibiotic. Many further tests must be done to isolate the actual specific bacterial organism. Knowing the gram status and general morphology (shape and pattern) can aid in eliminating possible antibiotic treatments. Most often, clinical experience and history is the best indicator of treatment regimen.

Examination of vaginal discharge:

The microscopic examination of vaginal discharge is done to rule out infections caused by gonococci (cause of vagninosis), *Candida albicans* (cause of vaginal candidiasis) and *Trichomonas vaginalis* (cause of trichomoniasis).

1. Collect the sample and prepare two slides.

2. On the first slide make smear of the discharge on a microscope slide and allow to air-dry. Stain with Gram stain and examine using the 40x objective then the 100x oil-immersion objective for *Candida albicans*. You are looking for Gram-positive yeasts, often with budding and/or short lengths of mycelium. Once again a bench reference manual is useful.

3. Immediately upon completion of the examination of the first slide, on the second slide add a drop of saline to the discharge and place over a coverslip. Examine for gonococci and *Trichomonas vaginalis* under the 10x and 40x objective. Do not allow the slide to dry out. Gonococci are Gram-negative and will look like small dots. *Trichomonas vaginalis* will be motile flagellates about 10-20 micrometers long with a clear nucleus.

Examination of male urethral discharge for gonorrhea:

1. Collect the specimen first thing in the morning before the passage of urine. First clean the urethra opening with sterile saline then apply a gentle pressure to the penis in so that a drop of pus appears on the meatus, this occasionally takes some gentle urethral massage to achieve results. Collect the pus using a sterile cotton swab.

2. Prepare a smear on a microscope slide and allow to air-dry. Apply a Gram-stain.

3. Observe under 100x oil-immersion objective. Look at the edges of the smear where the sample is more thin. Gonococci appear as Gram-negative intracellular diplococci.

Examination of other exudates and aspirates:

If you can collect it in a sterile manner you can stain it and look at it under a microscope. Some of the things which are common to examine using a Gram stain (and other more complicated stains not mentioned here such as the Ziehl-Neelsen stain and the Wayson stain for plague) plural fluid from the chest cavity, wound drainage, peritoneal fluid from the abdomen and fluid from the synovial joint space.

The important part about collecting these samples is that you should not do harm to the patient when collecting and you must collect in a sterile manner to prevent contamination from other co-exsiting (often skin) bacteria.

1. Take 10 ml of fluid and centrifuge to concentrate at a moderate speed for a few minutes.

2. Remove the supernatant on the top and re-suspend the deposit at the bottom using saline then using a fine wire loop (inoculating loop) that has been flamed to ensure it is sterile and cooled, prepare a very thin smear on a slide.

3. Air-dry and fix with methanol then proceed to apply a Gram stain.

4. Observe under 40x and 100x oil-immersion objectives for bacteria per the instructions above.

Examination of the watery stool:

Watery stool is often the clinical hallmark of *Vibrio cholarae* (cause of cholera) and the *Campylobacter* species in austere situations. It is can be examined with ease if your microscope has a dark-field attachement.

1. Take 200 grams of stool and place in 5 mL of sodium chloride solution. Wait some time for the large particles to settle out.

2. Using a fine wire loop (inoculating loop) that as been flamed to ensure it is sterile and cooled, prepare a very thin smear on a slide. Remove any large particles and cover with a coverslip.

3. Open the microscope iris fully and ensure the dark-field attachment is in place. Start with the 10x objective to focus (all objects floating in the saline solution will be bright, everything else will be dark), then move to the 40x objective to look for the characteristically shaped bacteria and things that are moving (motile). *Vibrio cholarae* will be motile rods which could be short, curved or involuted. *Campylobacter* are Gram-negative rods which are spiral and rotate quickly on themselves on a central axis.

Growing bacteria:

Most bacteria can be grown on simple agar plates. There are some that are difficult to grow (e.g. the bacteria causing tuberculosis), but the majority will grow. A sample of body fluid – urine, pus, sputum, etc. is spread on an agar plate using a sterilised (by direct heating in a flame) piece of wire in a narrow zigzag pattern. The plates are then cultured at temperatures in the high 30s Celsius (100°F). The colonies that grow can then be examined using the above techniques.

Agar plates can be made using the following techniques:

The agar should be placed into shallow dishes with a lid – Petri dishes (100 mm by 15 mm) are what are traditionally used but you can improvise.

Dissolve a vegetable stock cube and a gelling agent, usually 15 grams (1/2 oz) of agar, or one pack of all-purpose gelatine, or one jelly desert mix, in 1/2 cup (125 ml) of distilled boiling water. Make sure the gelling agent contains agar, carrageen, or guar gum.

To resterilise the dishes and lids place them in boiling distilled water. Leave them in the water to cool.

Pour the agar into a shallow Petri dish. It will form a jelly in each dish. Put the lid on and leave until the jelly is set. Store the dishes upside-down until you need them. This will stop water condensation from falling on the jelly.

A suitable reference would be the 2003 World Health Organization's publication entitled, "Basic Laboratory Procedures in Clinical Bacteriology".

The laboratory testing approach to fungi testing.

Tinea is a fungal infection of the skin. It can be found on the skin, in the scalp, on the nails and feet.

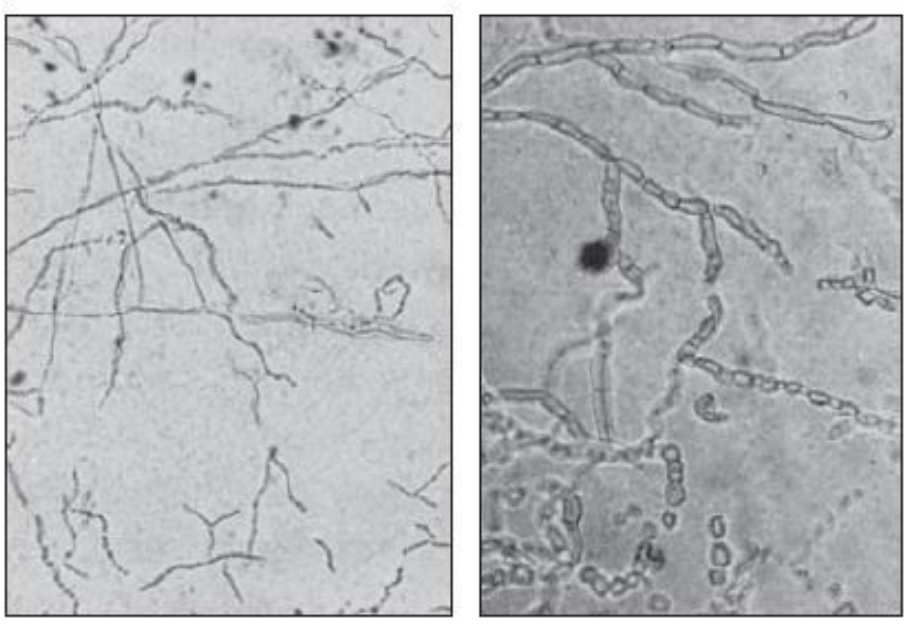
1. Clean the suspected area with alcohol and allow to air dry.

2. Using a sterile scalpel scape the suspect lesion scales onto a microscope slide.

3. Place a drop of lactophenol cotton blue on the scraping to kill live organism, preserve fungi and stain the fungal walls. Also place a drop of 20% potassium hydroxide onto the scales to break down the keratin in the tissue and allow the hyphae and spores to be seen. Cover with a coverslip.

4. Hold the slide above an alcohol lamp for 1 minute to clear the slide.

5. Examine under 10x and 40x objective ensuing good contrast using the diaphragm of the microscope. Branching hyphae with cross walls and septra are indicative of fungus. Use a bench reference manual to compare what you see to a known fungal infection.



(Left picture is 10x and Right picture is 40x objective)

Examination for parasites:

Parasites are living organisms that live in another living organism. The distribution of parasites is geographic and you would be well advised to know the resident parasites in your area and the diseases that they cause. In some parts of the world, parasites are very problematic causing notable morbidity and mortality. In other areas of the world only a very limited number are present.

The ability to detect parasites is very useful in diagnosing those illnesses that cause diarrheal illnesses, those conditions caused by worms and malaria which are devastating in much of the world.

The point-of-care testing approach to parasite testing.

There are a number of point-of-care testing options for detecting parasites. The advantage to point-of-care testing is that it is simple, requires little skill and the test kits are small/ lightweight. The disadvantage is that they can be expensive (especially when conducting multiple tests), are single use only. As such, you loose capability to diagnose when you run out of stock of the test kits.

The malaria test kit is the most common rapid detection kit in use. It is available from a number of manufactures. The best kits test for the plasmodium falciparum, vivax, ovale and malariae antigens. Most use a drop or two of blood and then are read 5-10 minutes after the addition of a reagent.

When picking a malaria test kit you want to ensure:

- It detects the plasmodium species. This includes a 75% positive rate when *P. falciparum* / *P. vivax* is at 200 parasites per microliter in the sample.
- It has a suitable shelf life and temperature stability.
- It is easy to use.
- The cost is affordable.
- The false positive rate should be less than 10% and the invalid rate should be less than 5%.

Other similar style point-of-care testing kits are available on the market. These include rapid test kits for dengue (for instance the VISITECT DENGUE test kit), Giardia/Cryptosporidium, *Entamoeba histolytica* (for instance the Quik Chek products by Techlab), *Trypanosoma* cruzi (the cause of Chagas disease), Visceral Leishmaniasis and *Schistosoma (the cause of* Bilharzia) in urine (Rapid Medical Diagnostics).

The laboratory testing approach to parasite testing.

Testing for schistosomes in the feces:

Schistosomes also known as blood flukes are parasitic flatworms. They are responsible for schiistosomiasis, the second most economically devastating parasitic diseases (after malaria). Although the flatworms live in the blood vessels of the abdomen and their eggs are microscopic they can be detected with a magnifying glass in the larval stage when hatching in the feces.

1. Take a walnut-sized chunk of feces and place in 250 mL of water that is clean and has never been chemically treated (chlorine or iodine). This could include rainwater or water that has been distilled. Using some sort of instrument break up the feces and mix with the water.

2. Take some cheesecloth and dampen with the clean water then place one or two layers into a funnel. Place the feces – water mix on the cheesecloth to strain and wait for one hour for the suspension to settle.

3. Being very careful take the top liquid off the suspension without allowing the sediment to escape. This can either be done by pouring or even better with a large syringe.

4. Add a small amount of clean water to the sediment and pour into a flask. Fill the flask to the top with more water. The flask must have a narrow, see-through neck. Look immediately with your eye, then a magnifying glass to see if larvae are present. These will be very tiny, white and swimming in straight lines.

5. Cover the lower part of the flask with aluminum foil and shine a light at the neck of the flask. Look at the neck of the flask with a magnifying glass while backing the flask up against a dark background. If you have seen larvae then you have larvae that are not schistomsomes, but rather something else unknown. Ideally if you have a microscope and the skills you can study these further under a microscope for identification. If you did see something at this point, stop the lab test as you will not know in the next step if it is schistomsomes that are present or the original non- schistomsome larvae you are seeing now.

6. Leave the flask at room temperature for 2-4 hours. If the solution at the top of the flask is cloudy something has gone wrong in your test and you will not be able ot see the schistomome eggs. Start over. If the liquid is clear and if schistomsome eggs are present they will hatch and release larvae. Check the flask again along the edges like you did in step 5. If you see larvae that were not there in step 5 then you have schistomsomes.

Testing for strongyloides and hookworms in the feces:

Normally you would search for strongyloides and hookworms with the use of a microscope. This obviously requires a microscope and parasitology skills. An alternative is to grow the worms until they reach a size that is detectable with the eye. Detecting strongyloides is important as the mediciation used to treat it is different then the medication used in general deworming protocols.

1. Take a 1/2" test tube and cut a piece of filter paper/coffee filter to the length and width of the test tube. Fold the paper in two lengthwise and then thirds crossways.

2. Smear some fresh feces in the middle third of the paper.

3. Add a little clean, non-chemically disinfected (with chlorine or iodine) water (distilled or rainwater is best) into the bottom of the test tube. Place the filter paper in the test tube as a long strip so that the bottom of the filter paper is in the water but do not allow the feces in the middle third of the paper to be immersed in the water.

4. Cap the test tube and store at room temperature. At days three, five and seven observe with a magnifying glass and good light. If you see very small, white, swimming larvae at day three then you are likely seeing strongyloides. If you see nothing at day three, but see larvae at day five or seven then you are likely seeing hookworms.

5. If larvae are present drop the whole test tube into boiling water to kill. Do not discard without killing, as they are infectious.

Microscopic examination of the feces for parasites:

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The skilled use of the microscope is an excellent tool in testing for parasites in the feces by direct microscopy. With minimal practice, it is possible to detect the single cell protozoa (both in motile trophozoite form and in ova and cysts form if the exist in a moderate number).

1. Place one drop of 0.85% sodium chloride solution, warmed to 37 degrees Celsius , (98.6°F) in the middle left half of a clean microscope slide.

2. Place one drop of an iodine-acetic solution in the middle right half of the same microscope slide. This solution is made by mixing 1:1 0.5% Lugol iodine solution with 50% acetic acid and then diluting and mixing it with four volumes of distilled water.

3. Take a small 2-3 mm portion of feces and place on the slide. If the stool is formed take a portion from the center surface of the sample to look for parasite eggs. If the stool is mucus containing or liquid take a portion from the surface of the mucus of liquid to look for amoebae. Mix the feces with the sodium chloride drop on the slide.

4. Take another small 2-3 mm portion of feces and place on the slide using the same sampling techniques as above. Mix the feces with the iodine-acetic acid solution drop on the slide.

5. Place a coverslip over each drop ensuring no air bubbles are trapped underneath the coverslip.

6. For the saline side of the slide examine using a 5x eyepiece and under the 10x and 40x objectives. Eggs and cysts are colorless so it best to use a lower light setting using the condenser aperture or lower the condenser to increase the contrast. Start with the 10x objective and move from the top left corner of the coverslip and cover the whole area in a systematic manner. You are looking for the ova and larvae of strongyloides. Then switch to the 40x objective and in the same manner search for motile trophozolites and cysts. Cysts will appear as transparent shiny round objects with well-defined shells. Under the 40x objective they will have a diameter of 1-3 erythrocytes. If cysts are seen they will need to be identified using a bench aid. Additional staining may be required to further differentiate the type of cyst found.

7. Move to the iodine-acidic acid coverslip and examine using the 40x objective. The solution will cause trophozolites to become non-motile. The nucleus of any existing pathology will be stained but it might be hard for the novice to differentiate between trophozoites and cysts.

8. Take one drop of a methylene blue solution and allow it to run under the saline coverslip. This will allow the nuclei of any cells present to show more clearly due to staining and provide better visualization of lobed nuclei of polymorphs from large single mucosal cells.

9. If you now add a drop of 2% eosin solution in saline the whole slide will come stained except for protozoa (most notably amoebae). These will remain colorless and very easy to detect.

10. The task as you see things will be to identify what you see. Occasionally what you see will be pathogenic and other times harmless. The identification can best be done with the use of a bench aid reference which shows high quality reference pictures.

> 10A. Special attention should be paid to identifying dysentery amoeba *(Entamoeba histolytica*) and differentiating it from the bacteria *E. Coli*. As a rule if a trophozoite moves quickly in one direction and projects pseudopodia rapidly, it is probably *Entamoeba histolytica*. Other species of amoeba do not normally behave in this manner. If the trophozoite moves as described and if erythrocytes are present in the cytoplasm, it can be assumed that it is *E. histolytica*. *E. Coli* looks and behaves differently in that it's motion is haphazard, it is non-or minimally motile, it has no erythrocytes as inclusionary bodies, it has a visible nucleus prior to staining in most cases and has an irregular nuclear membrane after staining. Karyosomes in *E. Coli* are large and eccentric versus small, dense and central in is *E. histolytica.*
>
> 10B. It is also possible that you will see motile flagellates. These could include *Giardia intestinali* or *Trichomonas hominis*.
>
> 10C. Finally, you may see helminthes, which detected by finding their eggs and larvae. Eggs under a 10x objective take up about 1/10 of the field. Under a 40x objective they take up about 1/3 of the field. Given the large number of species once again a bench reference is best used. Eggs are described by size, shape, color, stage of development, thickness of shell and any other special characteristics. It is possible to have more than one type of egg in a fecal specimen.

Microscopic examination for anal parasites (pinworm):

Pinworm also known as threadworm (*Enterobius vermicularis)* is a common parasite, especially in infants and young children. Infectious, it should be treated once diagnosed. The eggs are best collected in

children form the folds of skin around the anus. In the first world this is often done with cellophane tape but can as easily be done using a cotton swab.

1. Using a cotton swab wipe around (but not inside) the anus.

2. Make a 0.85% sodium chloride solution and place 0.5 ml (10 drops) inside a test-tube.

3. Rinse the swab well in the solution.

4. With a pipette draw up the liquid and place onto a slide with a coverslip and examine with a microscope. It is best to reduce the aperture and use the 10x objective. You are looking for *Enterobius vermicularis* eggs. This will easily be seen with the use of a bench aid if you are unsure what you should be searching for.

Microscopic examination of the blood for malaria.

There is no requirement to use the point-of-care test for malaria. In most parts of the world malaria is detected by means of simple laboratory microscopic examination, most commonly the thick-and-thin smear looking for the *Plasmodium* species. The thick-and-thin smear allows you to detect the *Plasmodium* on the thick side and identify the species on the thin side of the microscope slide.

The best time to collect the blood from the patient you suspect with having malaria is at the peak of their fever as the parasites will be most concentrated. Blood should always be collected before anti-malarial medications are administered.

1. Take the third or fourth finger (adult) or big toe (children) and clean with 70% ethanol to remove any dirt. Allow to air dry.

2. With a sterile lancet prick the finger and apply firm pressure to squeeze a drop of blood out. Discard this first drop of blood by wiping away with cotton. Ensure no cotton remains on the lanced site or contamination of the specimen will result.

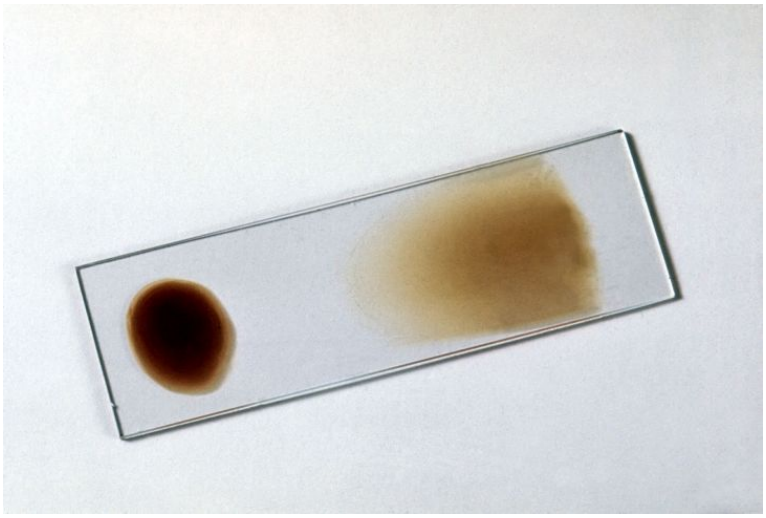
3. Work fast and only touch the microscope slide by the sides. Using gentle pressure, squeeze out a small drop of blood and drop on them middle of the slide. This will be for the thin side of the smear.

4. Apply gentle pressure again and squeeze out two or three larger drops onto the slide 1 cm from the first (thin smear) drop. This will be used for the thick smear. Place the microscope slide on a firm and flat surface.

5. Using another clean microscope slide as a spreader, touch the thin smear drop and allow the drop to run along the edge of the spreader slide. Keeping the spreader at 45 degrees to the smear slide and in even contact with the surface of the slide firmly push the spreader slide away from the thick smear drop spreading the small drop of blood into a thin smear.

6. Move to the large drops of blood on the slide to make the thick smear. Using the corner of the slide bring the drops together and make an even thick smear opposite the thin smear. Allow drying (ideally overnight) at room temperature protected from environmental contamination (dust, flies, touching). If

you do not have the luxery of an overnight dry time then fan the slide to dry or expose the slide to the gentle heat of the microscope lamp. Do not cook the slide or you will heat-fix the thick smear! Making a thick smear with the right thickness is somewhat difficult initially, but with practice you will quickly find the right thickness for examination.



Plasmodium species are often seen by staining the blood film you have just produced with Giemsa stain. The Geimsa stain dissolves the hemoglobin (dehemoglobinization) in the erythrocytes and all that remains will be the parasites (if present) and leukocytes which can be seen under a microscope.

1. Fix the thin smear by adding three drops of methanol. Try to avoid getting the thick slide of the smear to allow for optional dehemoglobinization.

2. Take nine drops of 10% Geimsa stain and place in 3 ml of buffered (pH 7.2) or distilled water and mix well with a glass rod. Note that this is for one slide, if you are doing multiple slides, multiply. Soak the slide by pouring or using a pipette. Allow the stain to be in contact with the blood for 5-10 minutes.

4. Add a few drops of clean water to flush any excess stain of the slide. Do not try and “tip” the excess stain off the slide and then wash or you will get a scum film overtop of your smears. Simply wash off the slide allowing the water to run off the edges on it’s own.

5. Place the slides in a drying rack, film smear side down and allow to dry. Ensure that the smears are not in contact with anything while drying.

Another staining technique is to use Field stain. It does not stain as well as Geimsa stain but is quicker to conduct. It needs to be done with the thin smear on one slide and the thick smear on another.

For the thick smear:

1. Dip the slide (not fixed with methanol) into a jar containing Field stain A solution for three seconds.

2. Wash the slide by dipping into a jar with water once for five sections.

3. Dip the slide into a jar containing Field Stain B solution for three seconds.

4. Wash the slide again by dipping to a jar with water once for five seconds.

5. Place slide upright in a drying rack to dry.

For the thin smear:

1. Dip the slide in methanol for 1 minute to fix.

2. Wash off the methanol with buffered (pH 7.2) water.

3. Using a pipette cover the slide with Field stain B that has been diluted 1:4 with buffered (7.2 pH) water.

4. Immediately add an equal amount of Field stain A and mix well by tilting the slide back and forth.

5. Wait 1 minute to allow the stain to take to the thin smear.

6. Wash the slide with clean water to remove excess.

7. Place slide upright in a drying rack to dry.

Examination under the microscope.

1. All slides should be examined using the 100x objective. Starting with the thick slide you will look for malaria parasites in some stage of development. This might require a good bench aid such as the World Health Organization – Bench Aids for the Diagnosis of Malarial Infections – 2000. Use care not to confuse a thrombocyte that is on top of an erythrocyte as a malaria parasite. If the thick slide was prepared well the background should be clean and free of debris as you lysed the erthocytes. The Giemsa stained parasite should have dark purple stained leukocyte nuclei possibly with little dots (Schuffner's dots) around the malaria parasite.

2. If parasites are found count the number in a microscope field. If you count over 10 parasites in a field then the patient is very ill and requires urgent treatment.

3. If malaria parasites are detected move to the thin smear and attempt to identify the species (*P. falciparum, P. malariae, P. vivax,* or *P. ovale)*. It should be noted that *P. vivax,* and *P. ovale* often are sparely concentrated on a slide so you may need to search over many fields for some time to find the. It is important to look for these two species, as the treatment for them requires conventional treatment as well as liver eradication. If the person as had malaria for some time monocytes may be seen in the thin film with the cytoplasm containing green or black bodies known as siderophils). If the patient has been taking malaria chemoprophylaxis or started malaria treatment it is also possible that the parasites will stain poorly or look distorted in nature. It is also important to remember that the patient may have more than one type of malaria at the same time.

Testing for visceral leishmaniasis in the blood:

Leishmaniais is caused by a protozoan parasite which is spread by a type of sand fly. About 200 million people in Asia, Africa, South and Central America, and southern Europe live in areas where the disease is common.

1. Take 3-5 ml of venous blood and transfer to a test tube without an anticoagulant in it. Let is sit upright without vibration or mixing at room temperature until a clot forms on the sides and bottom of the tube.

2. Take 1 mL of serum (the clear liquid on top) and place it in another tube.

3. Add one drop of 37% formalin and mix. Wait 20-30 minutes and observe. If the serum becomes white and gels the patient likely has leishmaniasis, especially if they have an enlarged liver/spleen. This test can also be positive in some cases of advanced AIDS and multiple myeloma. A test is negative if the serum does not turn white and/or does no gel.

Transfusion Medicine

Transfusion in the Austere or Survival Setting:

The collection, screening and administration of human whole blood is risky during emergencies inside of a hospital. Outside of hospital or in a disaster situation this risk increases notably. The risk of transfusing incompatible blood, blood that has become microbiologically contaminated due to storage or that contains a disease from the donor is real. Having to manage a transfusion reaction outside of a modern emergency room is complex and should not be taken lightly.

It is recommended that research and planning be given to the use of a walking blood back (WBB) prior to the requirement to transfuse blood in the austere setting. A process of screening, collection, testing and recording blood given will need to be established.

Donor screening:

Prior to taking blood for donation the donor should be asked a number to questions in private to rule out high diseases transmission behaviors. These include knowing to have HIV, Hepatitis B or C or active malaria. Using needles to take illegal drugs. Having transfusions in the past outside of a First World medical system, involvement in prostitution and homosexual sex.

Other risks worth inquiring about include being born in, or ever having sex with someone from Africa, especially Cameroon, Benin, Central African Republic, Chad, Congo, Equatorial Guinea, Kenya, Gabon, Niger, Nigeria, Senegal, Togo or Zambia.

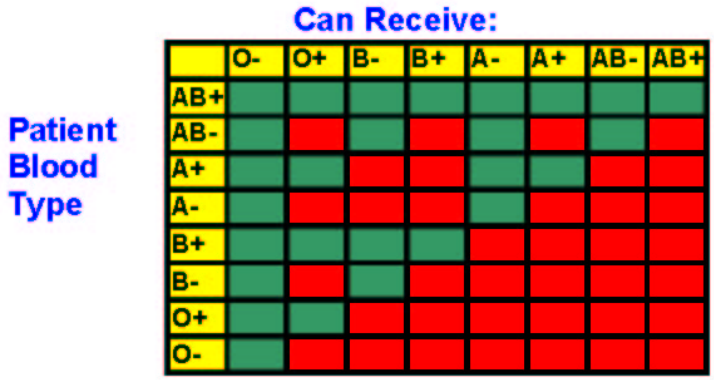
Finally having sex with a HIV or Hepatitis B or C infected partner, a partner who has had blood transfusions outside of a First World medical system, uses needles to take illegal drugs, uses illegal drugs, had sexually transmitted infections, has homosexual sex or is involved with prostitution also is worth

questioning as it increases the risk of a transfusion-transmitted disease from the donor who might unknowingly be carrying something from their sexual partner.

Subsequently, physical screening has the donor having a temperature less then 37.5 C (99.5 F), a blood pressure of less that 180/100 and pulse under 100 beats per minutes. For female donors, if time allows, the hematocrit should be greater than 38% or hemoglobin greater then 12.5 g/dL.

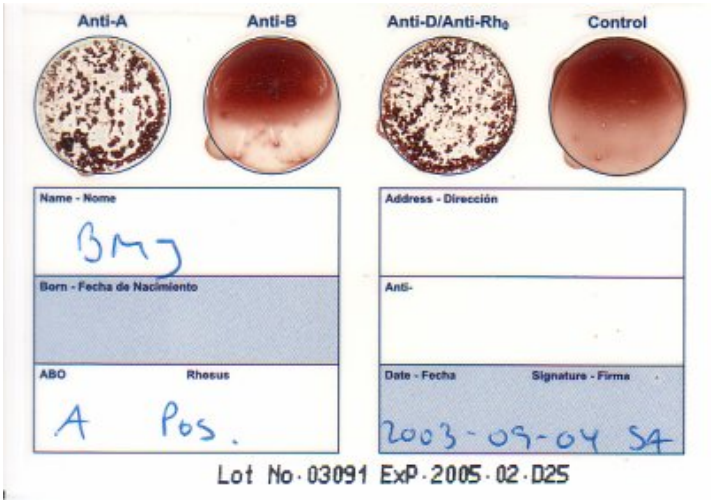
Blood Grouping:

There are four basic blood types: A, B, AB, and O. There is also an additional subgroup of each type of blood, Rh+ or Rh-. Some of these blood groups are compatible with one another some are not.

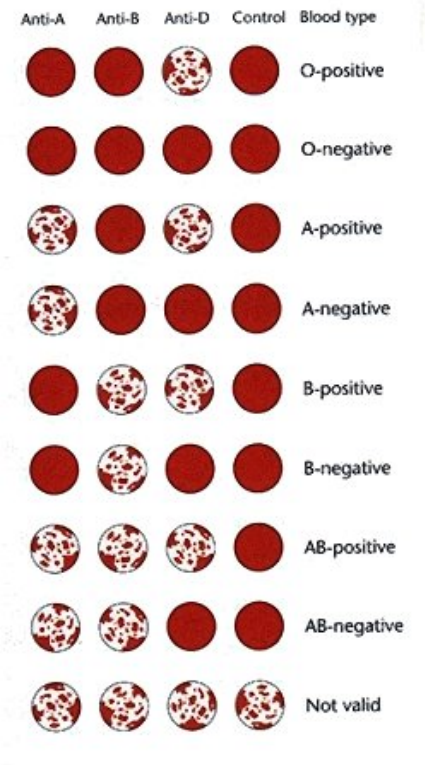


This chart shows the patients blood type on the vertical axis on the left, and the donor's blood type across the top. Note that O- blood type can be given to any patient, and that a patient with AB+ blood type can receive blood from anyone. There are other further subdivisions of blood that can make a whole-blood transfusion not as simple as the chart above, but it's a starting point. The simplest thing to do is have your group or expedition blood typed prior to your expedition or a disaster. However, provided you have several basic chemicals, a cross match is a simple test. If you are unable or unwilling to have this done (usually the Red Cross will give you a donor card with that information on it when you donate blood) there is another method that is nearly as simple. It should be noted that the distribution of blood types in the world is not universal but rather clinal and discontinuous. As such, if you are traveling remotely you may not be able to rely on the local population for the transfusion medicine needs of your group.

The EldonCard is a do it yourself kit to determine blood type and Rh factor. Anti-A, anti-B and anti-D/Anti-Rh solutions are placed on circles on the card. Blood is added to each circle including the control spot and mixed.



Then the drops are observed to see which agglutinated or "clumped together".



These cards are about USD $6-$10. The cards have a shelf life of roughly three years when stored in the refrigerator.

Cross matching:

Just having compatible ABO/Rh factor is not enough to assure a safe blood transfusion. To be certain that a transfusion will be safe a direct compatibility or "cross match" test is performed. There are several ways to perform a cross match. A saline cross match and an albumin cross match are two of them. The

albumen cross match consists of a drop of 30% bovine albumin added to a saline cross match. It requires bovine (cow) albumin that may not be available in austere conditions. Under ideal conditions both types of cross match are performed, and more.

Saline Cross match Method:

1) Take a few drops of the donor blood to be cross-matched and place it into a tube full of 0.9% saline.

2) Spin with a centrifuge.

3) You will be left with a small deposit of washed red cells in the bottom of the tube. Draw off the saline with a pipette to leave a deposit of nearly dry washed red cells.

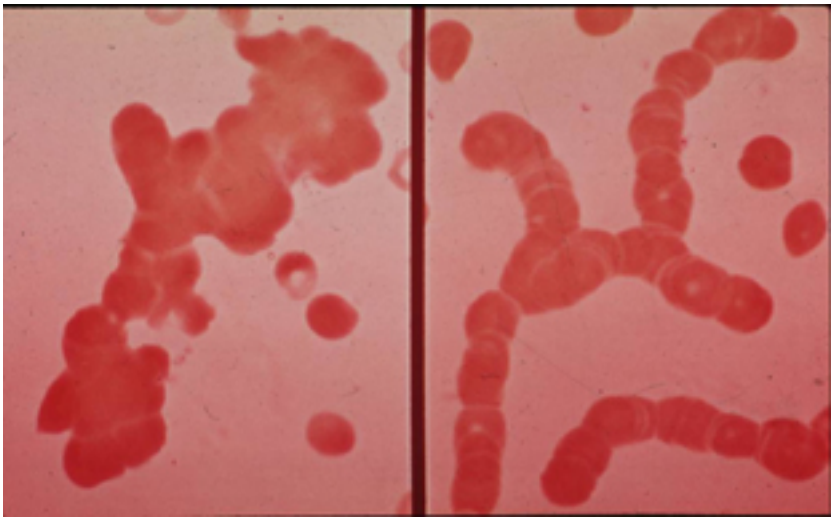
4) Add fresh saline solution to the cells in the bottom of the tube. You will add saline until there is approximately twenty times as much saline as red cells. Don't make the suspension too weak.

5) Separate the cells from the serum of the patient's blood by placing a sample in a tube and spinning it with a centrifuge. The cells will once again be in the bottom of the tube with the serum on top.

6) Place two drops of the suspension in a fresh, clean, sterile tube and add two drops of the patient's serum.

7) Mix and keep at body temperature for two hours.

8) Observe sample with a microscope. If the cells are clumping and sticking together this is agglutination, and the donor's blood should not be given. Sometimes cells will be stacked into neat rolls like stacks of coins. This is different from agglutination. This is called "rouleaux" and it is safe to give the donor's blood. Usually the rouleaux are easy to differentiate from agglutination but sometimes it is not. If not certain, do not give the donor's blood to the patient.



The sample on the left shows agglutination and demonstrates incompatibility. The sample on the right shows rouleaux as described above.

Disease screening:

Even blood that is ABO/Rh factor correct and a good cross match can still carry diseases from the host. This is one of the well-known risks within transfusion medicine. Donors who will be used as an emergency pool of blood (the walking blood bank) must be pre-screened before an emergency and provided education on how to avoid contracting diseases that would taint their blood.

If at all possible laboratory testing of blood must be done prior to transfusion. Rapid tests that can be done have been previously mentioned in this chapter and include HIV, Hepatitis B (HBsAg), Hepatitis C (HCV), Malaria and Syphilis (RPR).

Collection:

The antecubital fossa is prepared and catheterized using the largest IV catheter possible, ideally 16 gauge or larger. This assists in preventing the damage of blood cells through a small catheter. The blood is placed into a 450 mL bag containing preservative (most commonly CDPA) without going through a filter. Blood collected for walking blood bank transfusion should be administered to the patient immediately using standard techniques to reduce the risk of microbial growth from holding a room temperature.

Chapter 16: Sterilization and Disinfection

Throughout this book, we have tried to emphasize the importance of basic hygiene in any survival situation. This is especially true when performing any surgical procedure - from suturing a small cut or dressing a wound, to dealing with a major injury or performing an operation. This chapter provides an overview of how to clean, disinfect & sterilize surgical instruments and other objects.

Q. What is the difference between disinfection and sterilization?

A. An item is sterile when it is made completely free of measurable levels of microorganisms (bacteria, viruses, fungal spores) by a chemical or physical process of sterilization. Disinfection describes the process of destroying microorganisms or inhibiting their growth but is generally less absolute. All sterile items are disinfected but not all disinfected items are sterile. In some cases disinfection removes most but not all of the microbes, or removes all bacteria but not fungal spores, etc.

Sterility is only a temporary state – once sterile packaging is open or the product has been removed from an autoclave colonization begins almost immediately just from exposure to air and bacteria present in the environment.

Q. What is the difference between clean and sterile?

A. We have defined sterile above; clean is the absence of dirt. It is possible to have an item which is dirty yet sterile, i.e. the dirt is sterile. The gold standard is clean AND sterile. That said sterility is over-rated to a point. Clean items are sufficient to prevent infection in the majority of cases. Sterility is required when you are invading the body cavities or deep tissues. For the vast majority of minor cuts and lacerations clean is fine. Bulk unsterilised gauze is much cheaper than the same amount of sterile material.

Infection rates are no greater if a superficial wound has been irrigated and cleaned with tap water vs. being cleaned and irrigated with sterile saline. The studies supporting this are based on municipal tap water supply – so are not completely applicable to all situations.

There are different applications for each class of sanitized instrument. For intact skin, a clean instrument can be used. For mucous membranes & non-intact skin, you should use a disinfected instrument. Any kind of deeper tissue work or major surgery should always be carried out with sterile instruments.

Expendable supplies are used once and discarded. You will eventually run out of them no matter how much you have stored. They also create a medical waste problem and that waste can spread disease. Reusable supplies are just that, they last longer but not forever. If you have a choice, purchase a reusable item wher ever possible.

Methods of Disinfecting and Sterilizing Instruments:

Remember, the order of sanitation starts with clean, then disinfected, and finally sterile. A clean object is free from any visible debris, while a disinfected one is clean and most pathogens have been killed on it. A sterile object is the gold standard and should be clean and ALL microorganisms (bacteria, viruses, etc.) on it have been killed.

The current standard order of sanitation takes a dirty or bloody instrument to sterile in multiple steps. The steps are in place to protect those handling the instruments from acquiring an infectious disease from the blood or debris. The instruments are disinfected by boiling them or soaking in a chemical for a period of time, then they are scrubbed clean and finally they're wrapped and sterilized. This method is time consuming. In an austere setting the steps can be changed to save time and resources, but still provide a sterile instrument in the end. Start by cleaning the instruments, then sterilize or disinfect them, depending on the situation at hand.

Cleaning

Always begin by thoroughly cleaning the instruments, removing any visible blood, oils, dirt and debris from them. A good scrubbing under water should do the trick, though sometimes a bit of soap is needed. Be sure to rinse the soap off well if it is used. Make certain to open the instrument and clean the hinges. Inspect the teeth or serrations for blood and debris. After they're rinsed, you can lay them out to dry or begin wrapping them for sterilization immediately.

It's important to get the instrument as clean as you possibly can. Gross contamination can protect bacteria or viruses from the sterilization or disinfection process – when the dirt is removed the bacteria underneath can still cause infection.

Disinfection

Thermal disinfection

Boiling in water: Boil in water for 20-30 minutes (at sea level). In theory, the time should be increased by 5 minutes for each 1,000 ft rise in altitude, however, in practice this will have a minimal impact on sterility (the vast majority of pathogenic organisms are killed at temperatures of > 85°C (185°F) for several minutes) and simply wastes fuel. If your instruments where grossly contaminated by the previous patient - using these adjustments may be appropriate. The addition of 2% sodium carbonate will increase the effectiveness of the process.

Boiling will cause rusting of anything that holds an edge such as scissors and knives. Using distilled or soft water will reduce this problem. Do not start timing until the water has come to a full boil. Note that boiling will not kill spores but will kill HIV and hepatitis B.

Solar - for textiles, hanging in full sun and fresh air for 6 hours per side will disinfect.

Ironing- for textiles, heat the iron very hot and lay the textile on another textile that has itself been ironed. Steam lightly and make several slow passes with the iron.

Chemical disinfection

As a general rule, the chemicals used here are rendered inactive by organic material (i.e. dried blood and dirt). Be sure to clean your instruments well before relying on this method! The longer you leave the instrument in the chemical, the more bugs will be killed.

Alcohols (ethanol or isopropanol) You can ferment and distil your own ethanol although care needs to be taken so you don't produce toxic alcohols (e.g. methanol). Good for small cuts, surface preparation (including skin prep for surgery – toxic to deeper tissues and will sting ++), and for disinfecting instruments.

For instruments it is recommended that soaking in a 60-90% solution for >12 hrs is ideal. This time can be shortened to several hours by the addition of formaldehyde solution to the alcohol. 100% alcohol should not be used, as it is not effective.

Ethanol 70%, 8 parts of 90% ethanol in 2 parts water for 15 min.
Isopropanol 70%, 7 parts isopropanol in 3 parts water for 15 min.

Aldehydes: Have a high level of activity and can provide actual sterilization given the right circumstances. They are, however, toxic. Formaldehyde is a known cancer-causing agent and the smell is noxious and an irritant. Glutaraldehyde is 10 times more effective than formaldehyde and, though still toxic, it is safer than formaldehyde. An activator must be added before the solution will work. It is more active when it is buffered to an alkaline solution, though the solution is only good for about 2-4 weeks.

Formaldehyde 4%: Soak for 24 hours
Glutaraldehyde 2% buffered solution: 10 minutes
Not buffered: soak for 30 min.
Residual effect – rinse items well before use

Chlorhexidine: Sold OTC as Hibiclens or Nolvasan. It has a low level of activity (kills vegetative bacteria but not spores), low toxicity and has some residual activity when used as a scrub or skin prep. Use a mixture of chlorhexidine and alcohol to soak instruments for 24 hours to get a good disinfection.

Hypochlorite's (Clorox, etc)/bleach: 0.1% or 1,000 ppm. Bleach is useful for disinfecting surfaces and soaking instruments. Soak for 15 min but no longer than 30 min – bleach solutions are corrosive to metal instruments. The instruments should be rinsed upon removal from solution and dried. Production of bleach is described in Chapter 11: Long-Term Survival Medicine. Bleach breaks down relatively rapidly and most commercial solutions will have lost their active ingredients after 12-18 months.

Bleach in dilute concentrations can be used for wound care especially as a wash for burns. Start with a dilute concentration initially (1:60) if pain results from this concentration dilute it again by the same volume (out to 1:120), and increase the contact time.

Polyvidone-iodine (Betadine): For soaking instruments 1 part 10% solution (Betadine) to 3 parts water for 15 min.

Sterilization

There are several methods to achieve sterilization—moist heat, dry heat, chemical, gas, UV and irradiation. For our purposes, steam or dry heat sterilization will likely be the only methods attainable.

Packing:

The clean instruments should be opened to allow exposure of all hinged parts to be sterilized. Then stack them neatly on a clean cloth wrap. Fold the cloth over the instruments in such a fashion to allow the cloth to be opened easily and not touch the instruments inside. Use tape to secure the cloth.

The internal packing needs to be loose so the steam can circulate around all the items. Don't mix loads of dissimilar items if at all possible. Packs can be wrapped in paper (Kraft, newspaper, etc.) and/or a tightly woven textile. A double wrap is ideal for a shelf life of several weeks. Using autoclave bags will result in much longer shelf life but these are not always reusable. An ideal wrap would be a layer of cloth inside and paper outside.

Consider vacuum packing items in "boil in bag" pouches – this will enable them to be sterilized and protect against rusting.

TST test tape is an autoclave indicator tape. It changes colour when a load has been sterilised. It has a shelf life of 2 years from date of manufacture for reliable results. The tape will work with any steam sterilization, whether an autoclave or pressure cooker.

If an autoclave is available, use distilled water to fill the reservoir to the indicated level, then close the chamber door and start the process.

Using a pressure cooker as an autoclave:

An autoclave is a piece of equipment that has a chamber in which to place a surgical pack. The chamber is sealed tight, then heated and steam is pressurized in order to penetrate the pack and instruments and kill any microorganisms. High pressure steam sterilization can be achieved at home using a pressure canner/cooker.

Care of pressure cookers: You should clean after each use with
distilled water or fresh rainwater. Do not use detergents. Check the gasket, pressure vent, gauge, etc. You should check the manual which comes with your pressure cooker for specifics on maintenance. The manual is perhaps the most important piece of equipment as specific pressure cookers vary somewhat in operation, inspection, and parts. The most important information in the manual will be time variations,

how much water to add, and how to tell when it's safe to open it.

You should ensure you have spare parts, including a spare gasket (or two) and a safety plug.

Operating: Bring the pressure cooker to full boil with the weight off or valve open. When it reaches a full boil (like a tea kettle telling you it's ready - whistling) add weight or close valve and ONLY THEN begin timing. This is to evacuate all the air and replace it with steam.

If this is not done the needed temperature will not be reached and hostile organisms can survive.

Water: If possible use distilled or fresh rainwater. Hard water may cause layers of mineral deposits to build up and cause eventual failure if not cleaned regularly. Enough water must be used so the pressure cooker does not run dry; if it does it can seriously damage the pressure cooker and potentially turn it into a bomb.

Time, pressure, and altitude: **Do not begin timing until the pressure cooker is at full steam.** You can test to see when all air is evacuated by attaching a rubber tube to the vent with the other end underwater. When bubbles stop coming up all air has been evacuated. Time this and in the future you can make sure the pressure cooker has this much "warm up" time before you start timing. Run at 121°C (250°F) for 30 minutes at 15 pounds pressure at sea level add 5 minutes for every 500 ft gain in elevation. Use 40 minutes if cooking textiles.

Time and temperature for culture media is different. Some media will experience shifts in pH or destruction of some components if over-autoclaved. You should consult the information that came with the media for specifics.

Cooling off: The time required to cool off is load dependent; glass (can shatter) and culture media (which can boil and spatter) take the longest cooling time. The latter can take several hours of cooling time. For other items allow at least 30 minutes for the pressure cooker to cool before opening the lid. Quick cooling is possible by running cold water over it – but with glass inside this increases the chance of shattering.

The drying of packs should be done by placing in a warm place on a rack. Once the packs are completely cooled and dry, you can place them inside a plastic bag or container to protect them from humidity and moisture. The contents will remain sterile until they are opened or until moisture penetrates the packaging.

Dry heat sterilization:

Use caution when packing instruments – dry cloth or paper will catch fire at the temperatures needed to achieve sterilization. It's probably best to leave the instruments in a metal tray for this process.

Dry heat at 160°C (320°F) for 2 hours or 170°C (340°F) for 1 hour (Do not exceed 170°C or metal instruments may be damaged). Leave oven door open the first few minutes of heating to vacate any moisture and prevent rusting of metal items, and do not start timing till the desired temperature has been reached. This method is acceptable for surgical instruments, and high temperature glass, or plastics

but not for textiles. Oils, ointments, waxes, and powders should be heated at 160°C (320°F) for 2 hours.

Flaming:

1) Alcohol – dip the instrument in alcohol and set fire to it. This method is not reliable and will damage instruments in the long term but is better than nothing.

2) Heating in open flame till red hot. This method is reliable but should be used in emergencies only as it WILL damage the instrument.

Sterilization of specific items:

In this section we discuss what methods can be used for different items or categories of medical consumables and any caveats related to specific types of material you should be aware of. The following sections will deal specifically with how to do the actual disinfection or sterilising.

Syringes:

There are two types of syringes: disposable and reusable. The main differences relate to the material used to make the barrel and plunger of the syringe. A reusable syringe's body and plunger will either be made of glass or a plastic that can be autoclaved. The rubber on a "reusable" plastic plunger will break down with autoclaving or the glazing on the glass plunger will eventually wear out. Again, permanent supplies are not forever.

Reusable needles will generally have a luer lock attachment to attach to the syringe (as do many disposable ones) and will be made of a harder metal so they can be re-sharpened. They will also come with a needle plunger so anything trapped in the needle cylinder can be removed.

Disposable syringes will generally melt when heated to sterilizing temperatures but can be autoclaved several times before deforming beyond usefulness.

Contemporary practice is that diabetics using syringes to administer their insulin can reuse the same syringe for up to a week (SQ injections) if kept in a clean container and there is no need to sterilize them within this period. This could be extrapolated to reusing the same syringe when administering a series of injections of the same medication to the same person over a short-term period in an austere situation (**SOLELY** to the same person).

The best method to sterilise syringes is to autoclave them using a rack to suspend the barrel and plunger. The WHO has reported a 40% failure rate with other methods. A large part of this failure rate is thought to be due to laying the components in a tray. Any points of contact with a tray are areas the steam or heat cannot get to, so it's partially insulated, and some organisms may survive.

A rack should be made of metal and constructed so that the syringe bodies, plungers, and needles can be suspended in them with minimal contact with the rack itself so as to be hanging relatively freely. Racks can be easily made at home.

If you don't have a rack an alternate method is to wrap the plunger and cylinder in an OR towel and push the needles through the cloth. Nothing should be in contact with each other. Fold to make a pack and autoclave.

If you do not have access to a pressure cooker or autoclave, boiling is acceptable but a distant second choice.

The type of water used in an autoclave or pressure cooker will probably effect the life span of permanent syringes – the harder the water the less reuses – a very rough guide is: hard water = 50-60 reuses, soft water = 200+ reuses. It is impossible to say with certainty how long a glass syringe will last. Using hard water may also create maintenance problems for a pressure cooker although many home canners have used hard water for years with minimal problems.

Sharpening permanent needles:

Place a drop of light oil (sewing machine, light machine, or gun oil) on a fine sharpening stone. Draw the bevel (flat part of tip) of the needle back and forth at a uniform angle with no rocking. The goal is to keep the bevel the same length as on a new needle. Any rocking side to side will cause the bevel to become rounded and must be corrected. Rocking the angle of attack against the stone will cause at best, a dull needle and at worst, a hook on the point.

After sharpening for a bit, a burr will form on the sides of the bevel – this is a thin edge of metal. Remove it by gently drawing the needle on the side, to the top – forming 2 facets along the top of the point.

Always finish by giving one rub along the bevel and one to each facet.

When finished, check with a magnifying glass. Needles should be soaked overnight in trichloroethylene to remove any oil then polished with a soft cloth and water pushed through them to make sure the cylinder is clear

If you do not have access to oil and a solvent to remove it, then sharpen and clean (including inside the barrel – using fine wire) using hot soapy water.

This procedure should be done when the needle seems to be getting dull, not after every use.

Section 12.10 of “A Medical Laboratory for Developing Countries” by Maurice King has slightly more complete instructions along with very good illustrations for this procedure.

Surgical instruments:

The first part of this chapter deals with the various method of sterilizing instruments.

Instruments with opposing surfaces (scissors, clips) should be sterilized open. There is a risk of sharp edge rust - wrap scalpel blades and individual scissor blades in a piece of paper with a single fold this serves to wick moisture away and prevent rust.

The paper can be reused and in the case of scalpel blades, used as a storage container for the blades.

Scalpel blades and scissors can be sharpened with a fine stone. Metal instruments with moving parts can be lubricated with light machine oil or gun oil. Stainless steel can rust if the finish is scratched so should be handled with care. Sterilizing an instrument that has started to rust with those that have not will cause the rust to spread.

Dressings and other textiles:

Autoclave/Pressure cook.

Disinfection can be accomplished with the following methods:

- Ironing on a table covered with a drape that has been ironed and dampen each item with boiled water. The iron should be hot and several passes made.
- Hanging in full sunlight for 6 hours per side.
- Wash and boil for 5 minutes.
- Wash, rinse, and soak for 30 minutes in a 0.1% chlorine solution or 5% Lysol solution.

Gloves, tubing, and other rubber items:

Autoclave/Pressure Cook. Blow into the gloves to ensure no leaks; if leaks patch from the inside. Powder all rubber items with talcum powder prior to sterilizing and thoroughly let dry before storing or they will stick together. Repeated autoclaving will break down rubber.

Plastic Items (airways, syringes, etc):

The correct method depends on the plastic used in the manufacture and this may be difficult to discover.

HDPE (High Density Polyethylene): Translucent. Autoclave at 121°C (250°F) for no more than 15 min.

PP (Polypropylene): Translucent. Autoclave at 121°C (250°F),

PMP (Polymethylpentene): Clear. Brittle at room temp, can crack or break if dropped. Autoclave at 121°C (250°F).

PC (Polycarbonate): Clear. Autoclave at 121°C (250°F).

PTFE (Polytetrafluoroethylene): Not translucent. Autoclave at 121°C (250°F) or oven at 160°C (320°F) for 2 hours or 170°C (340°F) for 1 hour.

Glassware:

Autoclave/Pressure cook

Glassware can crack or shatter if the autoclave or pressure cooker is opened too soon. Pipettes may not fit in a pressure cooker.

Culture media:

Autoclave/Pressure cook.

It will boil and spatter if the pressure cooker is opened too soon.

Shelf life of prepared media:

- Tubes with cotton-wool plugs – 3 weeks
- Tubes with loose caps – 2 weeks
- Containers with screw caps – 3 months
- Petri dishes (if sealed in plastic bags) – 4 weeks

Chapter 17: Medical Aspects of Nuclear, Biological, and Chemical (NBC) Warfare

While it is possible to survive, an NBC (or CBR – chemical / biological / radiological, depending where in the world you are) attack any significant attack would result in serious medical consequences. The following chapter looks at medical issues relating to NBC/CBR attacks particularly focusing on small group issues. This is basic overview and further references should be consulted for more detailed information.

Government, Media and Information

These comments apply not just to CBR disasters, but really to any substantial man-made or natural disaster – however it especially applies when we are talking about CBR incidents.

It is important to not become too paranoid, but that said, a healthy degree of scepticism about information released by government agencies is required. Frequently it is inaccurate and if not inaccurate late – often too late to be useful. Government and Emergency Management authorities have repeatedly, over many man-made and natural disasters, consistently shown themselves to be very slow in delivering accurate information to the public. We are not suggesting any great degree of malice or a wider conspiracy, simply that any organisations with long chains-of-command with political oversite are by their nature sluggish and, by most conventional definitions, incompetent to a degree in the delivery of fast accurate information.

That said, it is important to listen to the media – often they will have important, potentially lifesaving advice. Focus on local media outlets – those in your town, city or county. National and regional news services are likely to be increasingly inaccurate initially. It can be a challenge to know what to believe but knowing your local conditions yourself and interpreting any government/ emergency management advice considering that is important.

If government advice appears to be contrary to local information on the ground – you will need to decide who you will believe – based on the route the advice has come to you, what it says, and how it sits with your local knowledge of the situation. In addition to chain-of-command delays, often information will be withheld for strategic reasons by law enforcement. There will always be a reason for this but it may be done on the understanding it will hurt a small number of people to provide an overall benefit to many people. If you are one of the few – you are considered colateral damage – again it isn't malice – it is simple economics – the greatest good for the greatest number. Hence all information needs to be interpreted with care and with an understanding of how government and government agencies think. They are not your friend – they are the "wider population's friend" – in that they, in theory, are looking out for the wider population - but at an individual level they may not be friendly at all.

The authors have repeated experience of inaccurate advice from Emergency Management agencies some of which, if followed, would have been fatal. But equally, some bulletins have contained lifesaving information – it is a conundrum with no perfect answer.

To quote Ronald Regan, quoting a Russian folk saying - *Doveryai, no proveryai* - "Trust, but verify".

There are three subsections – Nuclear, Biological and Chemical - under each heading three categories: Prevention, Equipment, and Medical preparations.

1. Nuclear

A. Nuclear Weapons.

Prevention:

Try to relocate to avoid living near a nuclear target such as a big city or military base. Avoidance of risk is the only valid prevention strategy.

The other aspect of prevention is the “stay or go” question. In the event of a nuclear attack or a smaller scale "dirty bomb" do you get out of the area or take shelter? The answer to the question is very circumstance-dependent:

- What is the time available – do you have enough time to get clear?
- Where you are vs. location of shelter – if you must back-track a long way to get to your shelter, continuing forward out of the danger zone may be more appropriate if you have time.

If you make the decision to get going – then really get going – don’t muck around or procrastinate – get clear of the area of risk immediately. If you make the decision to shelter in place – then take shelter immediately.

Immediate upon getting clear or immediately prior to taking shelter – strip off contaminated clothing and leave it in an area well clear of yourself or others and if possible, shower and wash all over including your hair.

Further details on sheltering and prevention of exposure to radiation or blast damage is beyond the scope of this book.

Equipment:

The most important thing to have is shelter. We recommend “Nuclear War Survival Skills” by Cresson H. Kearny. (http://www.oism.org/nwss/).This book discusses several low-tech approaches to nuclear survival. Most of the equipment recommended is standard in most homes or readily available.

The decision on the purchase of monitoring equipment is a personal one – Geiger counters or dosimeters. If you have a formal shelter and long-term supplies then there is probably a role for planning for monitoring equipment. If you are using an expedient shelter it would seem to be logical that you stay in your shelter for as long as practical and if forced to leave only do so for brief periods. If you are forced to leave, is there any value in knowing how much radiation you have received?

Care needs to be taken in what devices you purchase – there are many cold-war-era Geiger counters from both the US and UK available for sale from multiple vendors. The risk with these is that they simply don't work and you are relying on a broken device as a crucial device – there are solutions here in terms of testing and calibration – but you need to understand that buying on eBay without evidence of calibration or testing is foolish.

There are also many modern commercial Geiger counters and dosimeters available for purchase – for the most part these are good products. The problem is that their measurement range is often only from 0-1rad/Gy – dosages you are concerned about is in the 10-100s of Rads/Gys – so many would become useless in a nuclear incident as even 'safe' levels of exposure would take the meter off the scale.

Rad(Rd) vs. Grey(Gy)

N100/P3 masks should also be worn if venturing outside immediately following a nuclear incident. For most contamination, a simple shower will decontaminate you relaiably, however particles which have been breathed in or swallowed will not be removed and can continue to emit radioactive energy.

Medical Preparations:

An unsheltered person 1.5 km from a 1-megaton bomb could expect to receive about 500 rads of radiation from the initial explosion if they survive the blast and heat injuries. This level of exposure gives about a 50% survival rate. Simple sheltering from the initial blast significantly reduces this initial exposure.

Added to this is exposure from fallout (residual radiation) over the short to medium term. Issues such as the weather and ground or air explosion will have a big impact on dose of radiation delivered.

When considering clinical radiation effects they are broken down into:

- Immediate symptoms (0.5-6 hrs) – dose dependent
    - Nausea, vomiting, loss of appetite, and loss of energy
- Symptom-free period (3 hrs – 3 weeks) – dose dependent
- Second phase symptoms (1-2 days to 3 weeks) – dose dependent. Recovery or death occurs in a further 3-4 weeks
    - GI symptoms – nausea, vomiting, diarrhoea
    - Bone marrow suppression – infection, bleeding
    - Cerebral and vascular – very high doses cause blood vessels to become leaky, and chemical mediators to activate causing edema (fluid leaking from blood vessels) and shock. The brain is very sensitive to high doses and this leads to confusion, seizures, and coma. Patients presenting with cerebral and vascular signs and symptoms will die over a 1 to 2-week time frame.

In an austere situation without access to dosimeters the timing of onset of initial symptoms, and the length of the symptom-free period enable you to estimate very roughly the likely exposure, and mortality, and provide a guide for triaging medical resources. Patients who present only with GI and marrow suppression symptoms, with a delayed onset of initial symptoms, and a long symptom-free period may benefit from intensive management with fluid resuscitation and intravenous antibiotics. Those with early onset initial symptoms and a minimal symptom-free period, especially if they have brain symptoms and signs, will die, and treatment is wasted on them in a survival situation.

Cumulative exposure will give the following timing of initial symptoms:

<150rads: Minimal initial symptoms only. Increased long term cancer risks.
150-450rads: Initial symptoms can occur 1-4 hours' post-exposure depending on dose. Symptom-free period of 10-20 days. Deaths approach 50% at the top end of the range
450-800rads: Initial symptoms 30-60 minutes post exposure lasting 12-48 hours. Symptom-free period of 2-10 days. Deaths approach 100% at the top end of the range.
>800rads: Incapacitation soon after exposure, and death within 1-2 days with no symptom-free period.

Median lethal dose with no medical treatment is 350-400rads.

Table 1. Acute Radiation Syndromes

Whole Body Radiation from External Radiation or Internal Absorption

Phase	Feature	Subclinical range		Sublethal range		Lethal range	
		0-100 rad (cGy)	100-200 rad (cGy)	200-600 rad (cGy)	600-800 rad (cGy)	600-3000 rad (cGy)	>3000 rad (cGy)
Prodromal Phase	Nausea and Vomiting	none	5-50%	50-100%	75-100%	90-100%	100%
	Onset		3-6 hrs	2-4 hrs	1-2 hrs	<1 hr	<1 hr
	Duration		<24 hrs	<24 hrs	<48 hrs	<48 hrs	<48 hrs
	Lymphocytes			<100 @24 hr	<500 @24 hr	<500 @ 24 hr	<500 @ 24 hr
Latent Phase	Duration	>2 wks	7-15 days	0-7 days	0-2 days	None	
Illness Phase	Sign and Symptoms	none	moderate leukopenia	severe leukopenia, purpura, hemorrhage, infection		diarrhea, fever, electrolyte disturbance	convulsions, ataxia, tremor, lethargy
	Onset		>2 wks	2 days - 2 wks		2-3 days	1-48 hrs
	Organ System	none		hematopoietic and respiratory (mucosal) systems		GI tract, mucosal systems	CNS
	Hospitalization	0	<5% 45-60 days	90% 60-90 days		100% 90+ days	100% 2 weeks
	Fatality	0%	0%	0-80%	90-100%	90-100%	
	Time of Death			3 wks-3 months		1-2 wks	1-2 days

Acute radiation syndrome table from non-copyrighted Uniformed university handout

Radiation is not the only effect of nuclear explosions. A significant number of deaths and injuries arise from other effects of the explosion described above.

Heat: The thermal wave generated from the blast can cause serious burns. If you are planning for a nuclear disaster, then you will need to address the issue of burn management and stock your supplies accordingly.

Blast: Injuries occur for 2 reasons. First, damage from the pressure wave itself – ear, lung, and gut injuries are most common, and second, from collision with objects carried by the blast wave (wood, glass, nails), or the patient themselves colliding with solid objects when thrown by the wave.

Potassium Iodide: Radioactive isotopes of iodine can be taken up by the thyroid gland following a nuclear blast. This causes a significant risk of thyroid cancer. By taking a potassium iodide or potassium iodate supplement (approximately 76% iodine); the uptake by the thyroid gland can be blocked to a degree. The dose is 130 mg once a day starting before exposure and continuing for 10 days. Potassium iodate has been shown to be more palatable to children as it tastes much less bitter in comparison to iodide.

Prussian Blue: The FDA has determined that the 500 mg Prussian blue capsules, when manufactured under the conditions of an approved New Drug Application (NDA), has been found a safe and effective for the treatment of known or suspected internal contamination with radioactive cesium, radioactive thallium, or non-radioactive thallium. This determination is based on a careful review of published literature articles containing reports, data, and experiences of people who were exposed to high levels of thallium or cesium-137, and who were treated effectively with Prussian blue.

http://www.fda.gov/cder/drug/infopage/prussian_blue/Q&A.htm#1

Other blocking options: While there is evidence to support potassium iodide and Prussian blue there is little evidence supporting other blocking agent. Russian scientists following Chernobyl have suggested that the ingestion of excessive calcium in combination with vitamin D **may** decrease absorption of radioactive strontium. Strontium has a known affinity for bones. The excess calcium **may** be taken up in place of some of the otherwise bio-available strontium leaving the rest to be cleared from the body without deposition. This is scientifically sound theory although there is no evidence demonstrating a benefit but no reason to think it would be harmful.

B. Nuclear Accidents.

Nuclear accidents such as Chernobyl and Fukushima have occurred as random accidents. It is possible/likely that over the next decades that there will be further accidents involving individual nuclear power plants – it is likely these will be like the previous incidents and are most likely to involve the release of radiation rather than large amounts of heat or blast damage (although that is possible).

The general approach to the prevention of radiation exposure and subsequent medical management remain similar, although the isotopes involves from a civilian reactor meltdown will be different to a nuclear detonation. Practically the same approach is required – evacuate if possible, take shelter if not possible to evacuate.

2. Biological

Biological warfare has a long and sordid history – some of the earliest reported cases were using bodies of patients infected with typhoid used to contaminate drinking water or throwing small pox victims over the walls in Cities under siege.

The infectious agents described here are included because they can be weaponized, but it is important to remember that these agents also cause natural disease. Generally, when occurring naturally, cases of the disease will occur slowly in small clusters and build-up in clearly defined 'pockets' versus a weaponized strain where the disease is more likely to occur outside its usual environment or population, move much faster, and infect more people than you would usually expect to see for that microbe.

The perfect biological weapons agent has certain characteristics:

- Highly infectious with a short incubation period – if you are exposed you catch it.
- Cause death or serious complications which are a drain on medical resources.
- Dispersible – it can be delivered over a wide area, easily.
- Treatment options are non-existent, rare or expensive.

Some of these diseases in their natural state don't meet these criteria – so they need to undergo the weaponization process.

Prevention:

There are three important steps:

Hygiene is the single most important step to prevention illness/death from the use of biological weapons or biological agents in general. This includes clean drinking water, proper waste disposal, and hygienic food preparation, cooking, food storing, and slaughter of animals. Make sure that you have strict guidelines relating to hygiene, and that everybody in your group understands and follows them.

The next is to keep up to date on vaccinations – prevention is way better than trying to find a cure.

Third have access to a high filtration (P3/N100 – discussed below) face and nose mask at very short notice – ideally a full-face mask covering the eyes as well or tight fitting goggles. While many biological agents can be spread by skin contact – the clear majority are spread by respiratory contact alone or respiratory or mucosal contact (i.e. the eyes).

You should retreat from public spaces as quickly as possible.

At home, establish a quarantine room for anyone who is sick. This is best done in a bathroom with a fan on that creates negative pressure and blows outside. Quarantine the bedroom outside the bathroom – try and use the master bedroom and set up a decontamination line for protective clothing within it. Bathrooms have easy-to-clean surfaces as well.

Surfaces and suits can be cleaned with bleach solutions made from stored pool shock, diluted.

If no one is infected within your group, you need to implement reverse quarantine. Reverse quarantine is simply locking you and yours up in your home and not accepting visitors – this needs to be absolute. Late arriving family can stay in a tent in the yard for double the incubation period of the known pathogen from last outside contact – before being allowed in. If the incubation period is not clear – then 14 days is a reasonably safe period. You need to have markings/signs to warn others away and a plan/will to enforce it.

You need to have a plan to stop going to work or out in public and setting up a quarantine for the ill that you decide you cannot care for.

Do a risk analysis of what you believe is the biggest biological threat for your group. Some infectious diseases (measles, polio, diphtheria) are returning because childhood vaccination rates are falling.

Equipment:

First, get what is required for basic hygiene and cleanliness – brooms, dustpans, mops, bleach, disinfectants, etc. Second, get specific items for dealing with infectious disease. Simple barrier precautions will protect you from most infectious agents.

i. Hand washing
ii. Mask: Varies from a simple paper mask to a full gas mask unit. Paper masks must be certified to the N95 or N100 standard. This refers to the filtration rate for a given particle size rather than the size of the particles themselves. i.e. an N95 is rated as filtering greater than 95% of all particles 1.0 microns or larger in size. These standards are effective for protection against many infective agents, not all (especially some viri), but they reduce the changes of inhalation significantly. If you purchase gas masks then you must ensure that the filter is against biological agents and not simply chemicals. The masks must be sized to the individual – find the correct sizing needed before you need to depend on them.
iii. Gloves: These reduce the degree of skin contamination but are not an alternative to frequent hand washing.
iv. Gowns: These provide an additional layer of protection and reduce regular clothing contamination
v. Aprons: If there is a lot of potentially contaminated body fluids, a water-impervious apron offers a further layer of protection and stops large volumes contacting a gown.
vi. Over-suits: A waterproof over-suit combined with mask and gloves offers the most complete protection. *Be aware though that the more complicated the personal protective equipment is, the more likely you are to contaminate yourself getting out of it*. This problem was a cause for many infections during the 2013/14 Ebola outbreak.

    Have a designated assistant who is responsible for spraying you down with disinfectant and then supervising you scrubbing yourself down and removing your protective equipment. Practicing this in advance of a biological or chemical emergency is important and is something that lends itself well to practice in advance.

It is vitally important to wash your hands at the end of the process. Again, there are many cases of accidental contamination with a finger or hand contaminated in the de-gowning process.

Medical Preparations:

It is not practical to keep on hand supplies to deal with all biological possibilities. So, consider stocking up on what is likely to cover the most diseases. We recommend where it is possible storing ciprofloxacin and doxycycline. Also stock up on IV fluids and antipyretics, such as paracetamol (acetaminophen).

During a biological attack, it may take several days to identify the agent but it is likely that early on you will know what you are dealing with.

Common Biological agents:

Inhalation anthrax
Symptoms: Short period with non-specific flu-like symptoms. Often a symptom-free period, then one or two days later, the patient develops high fever and shortness of breath often associated with coughing up blood.
Primitive treatment: Doxycycline or Ciprofloxacin.
Inhalation anthrax is not contagious but has a high death rate.

Tularemia
Symptoms: Fever, shortness of breath, fatigue, malaise, cough, and abdominal pain.
Primitive treatment: Doxycycline or ciprofloxacin.
Simple barrier precautions should be sufficient as Tularemia is usually not contagious.

Pneumonic Plague (*Yersinia pestis*)
Symptoms: Fatigue, fever, cough, shortness of breath, and malaise.
Primitive treatment: Doxycycline or ciprofloxacin.
Pneumonic Plague is highly contagious, and caregivers need to protect themselves from droplets. Fleas on rodents also transmit plague zoonotically – keep the rat population under control and there will be fewer rats to spread the fleas.

Botulism
Symptoms: Blurry vision, difficulty speaking and swallowing, sore/dry throat, dizziness, and paralysis.
Primitive treatment: Supportive. Prolonged (weeks) mechanical/manual ventilation may be required.
It is not contagious.

Smallpox
Symptoms: Fever, rigors (uncontrolled shaking), malaise, headache, and vomiting. After a couple of days, a pustular rash develops on the hands, face, and trunk.
Primitive treatment: Supportive.
High contagious - both contact and airborne.

Viral Hemorrhagic Fever
Symptoms: GI bleedings, petechia, bleeding from mucous membranes.
Primitive treatment: Supportive.
Some VHFs are contagious. As a rule, in primitive conditions assume all suspected cases are highly contagious.

Brucellosis (*Brucella melitensis*)
Symptoms: Fever, headache, sweating, chills, back pain.
Primitive treatment: Doxycycline + rifampicin.
Usually nonfatal. Found in animal reservoirs in cows, pigs, goats, and sheep. Can be transmitted as an aerosol or through contact with body fluids. Second-line biological agent due to low kill potential but has the potential to overwhelm medical services due to epidemic outbreaks.

Encephalomyelitis
Symptoms: Fever, headache, severe photophobia (aversion to light).
Primitive treatment: Supportive.

Alphavirus infection (Eastern, Western, or Venezuelan Equine Encephalomyelitis)
High mortality. If occurs outside endemic areas may indicate biological attack.

Meliodosis and Glanders (Burkholderia pseudomalleri)
Symptoms: Pneumonia with associated septicemia. Meliodosis may occur in the form of localized lesions.
Primitive treatment: Ceftazidime for acute infection, doxycycline to prevent recurrence.
Normal infection occurs via contaminated soil or water in endemic areas. Dispersal can be via aerosol in a biological attack. This disease is endemic in northern Australia and is a common cause of pneumonia and skin infection presentations in the 'Wet' season. Second- line bio agent.

Psittacosis (*Chlamydia psittaci*)
Symptoms: Atypical pneumonia with fever and cough.
Primitive treatment: Doxycycline.
Rarely fatal. Transmitted naturally to humans after contact with infected bird droppings. Second-line bio agent.

Q-Fever (*Coxiella burnetti*)
Symptoms: High fevers, chills, sweats, headache.
Primitive treatment: Doxycycline or Chloramphenicol
Human transmission usually from inhaled dust infected with placental tissue or secretions from infected sheep, cows, or goats. Rarely fatal. Second-line bio agent.

Typhus fever (*Rickettsia prowazekii*)
Symptoms: Fever, headaches, chills, generalized pain and rash.
Primitive treatment: Doxycycline or Chloramphenicol.
Moderate fatality rate. Transmitted from infected person to infected person by human body lice.
Second-line bio agent.

Ricin (technically a chemical agent)
Symptoms: Block protein synthesis within the body. Abdominal pain, diarrhea, nausea, vomiting, severe diarrhea. Pneumonia if infection by inhalation route. Cardiovascular collapse.
Primitive treatment: Supportive.
Derived from the castor bean. Highly potent. Inhalation following spraying is most likely route of spread.

There are also many naturally occurring diseases which can present in epidemic form and spread rapidly in the human population (such as SARs, Influenza virus – like H5N1 or Ebola) which come and go in the localized epidemics of infections. The risk with these agents is they take on pandemic properties (see chapter 7 for a discussion of pandemic agents) and spread rapidly around the world. Some argue that there are suggestions that governments are involved in engineering pandemic strains of these diseases and introducing them into the population. Regardless of whether this belief is just a conspiracy theory or a fact – the reality is that these agents can be weaponized with the right technology and motivation.

Supportive Treatment:

The treatment of many biological agents is described as supportive care. This is the support of the body's organ systems (heart, brain, liver, kidneys) to help them continue to function following damage but is not specifically aimed at treating the underlying injury or disease. It is usually delivered in an intensive care unit and consists of treatments such as oxygen, ventilation, dialysis, fluid therapy, nutrition, and using medications to maintain blood pressure. This is in addition to antibiotics if they are appropriate. In an austere situation, your ability to deliver supportive care will be minimal and potentially a massive drain on limited resources. Within an austere environment, it may be possible to hand ventilate a patient for a limited period (prolonged ambu-bag ventilating is extremely demanding on the hands, and in our experience a single person cannot do it for more than 20-30 minutes at a time), and administer IV fluids. But intensive supportive care beyond that is simply not practical. Prolonged field care/field critical care is discussed in chapter 6

Nano-Particle Pandemic

This is a new and emerging threat. Nano particles can be used to trigger change at a cellular level in the human body. The initial presentation is likely to be a rapidly progressing hemorrhagic event that is characterized by minimal delay from exposure to death in the same day. A substantial difference between nano-particle infection and a normal bio-warfare infection is that the bodies remain highly contagious for an extended period, and all animals may be affected, and the disease can spread from them. Airborne spread is also very likely.

After a highly variable time, the particles may degrade in the environment and risk reduces – however in the short to medium term the risk remains high. There is no practical treatment for nano-particle infection.

3. Chemical Weapons

The simple definition of a chemical weapon is the spreading of a chemical agent with the intent to do harm. Fortunately, most agents used in this manner cannot hurt more than a few people given the wide number of potential chemicals that do harm.

In the form above, chemical weapons have been used for 100's of years, but it is only really since the First World War that their use has been concentrated and methods of delivery refined. The main chemical agents are discussed below – but the full list is vast. Fortunately, most cannot be weaponized beyond local contamination of small areas and small numbers of people.

Prevention:

The only prevention is avoiding exposure. Since it is likely any exposure would be the result of a terrorist attack it may be difficult to avoid. The best option is to ensure that you have access to your mask always – you have to decide the level of risk within your community to . Make sure you train with your mask and filter and can ensure it properly fitted. *If dealing with a patient of suspected chemical agent poisoning ensure you are protected and that the patient is decontaminated.*

Where formal decontamination is not possible – remove, and dispose of the patient's clothes and wash the patient down with soap and water.

If you suspect a chemical attack, try and stay up wind from the location and on the high ground. Chemical agents will be carried by the wind and as most are heavier than air, the chemicals will settle in low-lying areas. Inside, try and find a room with minimal windows (ideally an interior room with no windows), tape cracks around doors and windows and place a wet towel around the base of the door.

Equipment:

The single most important piece of equipment is a protective facemask and appropriate filters for all the members of your family. Ensure that your filters meet the standard for both biologicals and organic chemicals, and that you have spares. Beware of military surplus masks; the quality in some cases is questionable.

The appropriate military filters will provide protection against chemical agents. Buying the correct civilian filter can be more difficult. The following is the Australian commercial standard for mask filters which is the most appropriate for this application: **A2B2E2K2 Hg P3.**

"A" protection against organic compounds with boiling point > or = to 65°C (149°F). **(Most nerve agents)**
"B" protection against Inorganic gases and vapors e.g. chlorine, hydrogen sulphide, hydrogen cyanide **(most blood agents)**
"E" protection against sulphur dioxide, hydrogen chloride and otheracid gases.
"K" protection against ammonia and organic ammonia derivatives.
"2" is the filter class and means a maximum permissible concentration of toxic substance = 0.5%vol% (5000ppm)
"Hg" is protection against Mercury.
"P3" particulate filter at the highest class **(most viruses + radioactive dust)**

In the US, suitable commercial filters are “violet ring” (M95 particulate/organic solvent/radon) rated 40mm thread. The military spec is C2A1 Military Spec NBC filter with a NATO thread (40 mm).

The mask protects you from vapor and gas. A protective over-suit protects you from liquid and dense vapor contamination on your skin. Usually liquid does not spread over a wide area while vapor can disperse over wide distances. Vapor is poorly absorbed from the skin. It can be absorbed if the vapor is dense enough but this is only likely close to the release point. The need for skin protection is particularly a problem with blister agents. For most people the priority is the purchase of appropriate gasmasks before considering over-suits. If you are unable to afford commercial chemical protective suits consider purchasing those recommended for spraying agricultural chemicals; they do offer the same level of protection but are cheaper, and many nerve agents are based around organophosphate agricultural sprays.

Medical Preparations:

Chemical decontamination

If you are exposed to a potential chemical agent, hold your breath as long as you can, squint or close eyes and move upwind as far as you can. Next begin by removing all clothing and flap your arms to try to assist off-gassing volatile chemicals.

If possible, move to your car or indoors for further decontamination with soap and stored drinking water. Try to not spread contamination further.

If no additional help is coming, home decontamination is the next step. Remember the municipal/town water may also be contaminated. Well/bore water is typically safer. If you need to travel, your car provides almost no protection, so use caution, as multiple areas can be affected by the chemical incident.

Typically, a hasty decontamination station can be set up with a water storage container and with the decontamination point that is oriented with movement proceeding in the upwind direction.

Stainless steel buckets with long handled scrub brushes and heavy rain suits with boots and gloves are should be available in the kit as well. A standard 10l fire extinguisher that can be recharged with an air pump or a backpack spray set which can be pressurized also helps a lot for the rapid cleansing of cars, gear, and people.

Calcium hypochlorite or pool shock can be mixed into the decontamination solution to neutralize via oxidation almost all chemical agents – water by itself is better than nothing, but if available a chlorine solution is much better.

In the author's setting, this would be set up on the driveway into their farm, presenting contaminated people from messing up the wider farm. We would leave all vehicles off the farm initially due to risk of contamination and the complicated nature of decontaminating a vehicle. Ideally the last entrance to the home should have a separate entrance going into a bathroom with a shower for final decontamination and warm up after outdoor decontamination has been performed.

If the threat occurs while you are in or near a building, then a hasty shelter should be made within a small room in the house. Seal it completely with tape and plastic sheeting. Wet towels under the door worked for some in gas attacks in Iraq or Syria. In sealing the room, make sure you do not asphyxiate yourself or your family. A good rule of thumb: hold your arms out to your sides and spin. That amount of space gives you one hour of air in a typical room. Don't use any agent which produces carbon monoxide – gas lights, gas stoves or BBQ's. Dogs use a lot more air for size than humans – so be aware of this if you bring animals into the shelter. Remain sheltered in place for as long as possible.

Most agents are very volatile and off-gas quickly with the exceptions being some blister agents, but these are not as big an inhalation hazard and simple water-proof coverings can offer a degree of protection.

In a truly austere situation, a mild soap is still the recommended low-tech decontamination agent for suits and bodies. Obviously, care must be taken during the decontaminating process especially decontaminating around your own mouth and eyes.

Chemical weapons are divided in three types: Nerve gas, Blood agents, and Blister agents.

Nerve gas: GA(tabun), GB(sarin), GD(soman), GF(cyclohexyl sarin) and VX
Nerve gas can cause sweating, excess saliva, excess respiratory secretions, tachycardia (fast heart rate) or bradycardia (slow heart rate), abdominal cramps, vomiting, muscle twitching, headache, seizures, confusion, and coma. They cause their effects by blocking the breakdown of acetylcholine – a communication chemical between nerves and muscles. When the enzyme, which breaks it down, is blocked, it accumulates, and causes the symptoms of nerve agent poisoning.

Treatment: Pre-treatment: This consists of the administration of medication prior to exposure to a nerve agent to minimize the effect of the agent. This is only useful if the chance of exposure is high and there is some warning. The agent of choice is Pyridostigmine 30 mg every 8 hours. These binds reversibly to the same receptors to which the nerve agents bind irreversibly helping to reduce their effects. This was tolerated for prolonged periods by troops during Gulf War 1 with minimal minor side effects. If exposure occurs then pre-treatment combined with post-exposure treatment significantly reduces the death rate.

Post-exposure treatment: This should be administered immediately upon suspicion of exposure to nerve agents (i.e. high risk situation plus unexplained salivation, excess nasal secretions, shortness of breath, muscle twitching). There are 3 components:

1. Atropine: 2 mg by IM injection repeated up to 3 times in 30 minutes if symptoms are persisting or worsening. Large amounts of atropine may be required, but the indications and administration are beyond the scope of this book. The dose is titrated against signs of atropinization: dry mouth, dry skin, and tachycardia > 90/ minute. In the complete absence of medical care and confirmed nerve agent exposure, atropine can be continued to maintain atropinization for 24 hours (usually 1-2 mg Atropine 1-4 hourly). Atropine effects are essentially peripheral and it has only a limited effect in the central nervous system.

2. Oxime treatment: While atropine minimizes the symptoms, it does not reverse the enzyme inhibition caused by the nerve agent. By administering oximes, this encourages the reactivation of the enzymes required to breakdown the acetylcholine. Different oximes work better with different nerve agents - usually a mix of Pralidoxime and Obidoxime is given.
3. Anticonvulsants: In severe exposures, there is the risk of seizures leading to serious brain injury. Atropine has a limited effect in the brain. Diazepam is the drug of choice and can be given 10 mg IM repeatedly to control the convulsion.

Patients with severe exposures may also require assisted ventilation and suctioning of their airways. Hand-ventilation may need to be continued for a prolonged period – from an austere medicine point of view, foot powered boat inflating pumps can be configured to deliver the correct tidal volume (roughly 500-600mls per breath) freeing up your hands, and also the mechanical monotony of bagging a patient. It is always important to remember when hand ventilating a patient, that slow and gentle breaths remain very important.

While pre-treatment and initial first aid treatments are relatively straight forward, the ongoing medical management of patients exposed to nerve agents is complicated. If you do have access to the antidotes, please follow a reputable NBC or toxicology references to confirm the advice above and find further information about ongoing management.

If you can get access to military auto-injectors then this is ideal first aid/initial therapy. There are 3 common brands of auto injectors:

Combopen (UK)	500 mg Pralidoxime, 2 mg Atropine, 10 mg Avizafone
Combopen (Aust)	220 mg Obidoxime, 2 mg Atropine
Mark 1 (USA)	600 mg Pralidoxime, 2 mg Atropine

Pralidoximine is available in vials and in auto-injectors by itself also for organophosphate poisoning.

Blood agents:

The most common of these agents is cyanide or its derivatives. They work by blocking cellular respiration. It is mainly spread by aerosol. If the patient survives the initial contact then it is likely that the patient will survive. The spectrum of symptoms runs from weakness, dizziness, and nausea through seizures and respiratory arrest. Another example would be sulphur dioxide – a naturally occurring gas generated when organic materials rot – it is hard to weaponized over a large area – but it is possible to kill and injure people in confined areas, especially if oxygen is displaced as well.

Treatment:

Remove from exposure area and decontaminate the patient.
There is no true austere management. Where possible provide 100% oxygen and assist with ventilation (this is the single most useful step). There are 3 options for therapy:

1. Hydroxycobalamine: 5 gms IV – safest therapy.
2. Amyl nitrite (inhaled – usually a temporizing measure until IV medication can be given) or sodium nitrite 300 mg IV over 10 minutes followed by sodium thiosulphate 12.5 gm over 15 minutes. This combination forms the commonly available “Eli Lily kit”.

3. Dicobalt edetate 600 mg followed by sodium thiosulphate – very toxic therapy and least ideal of the three.

Blister agents:

Blister agents include Lewisite and Mustard gas. These cause damage to the skin and when inhaled damage to the lungs. Mustard gas can also cause suppression of the bone marrow; if this occurs in an austere situation death is likely from infection.

Treatment:

Protecting yourself from contamination is the priority. Decontaminate the patient.
Irrigate burns with large amounts of water or Milton's solution if available. Leave small blisters alone. Deroof large blisters (remove the loose overlying skin) and irrigate frequently with water and soap. Antihistamines may be useful to control itch. Eyes should be irrigated with copious amounts of saline initially then daily irrigations. Where available antibiotic eye drops should be used. Upper airway symptoms may respond to steam inhalation or cough suppressants. In the case of Lewisite exposure there is an antidote (BAL aka Dimercarprol) for systemic exposure. For mustard gas, there is a specific decontamination powder but it is not readily available.

Asphyxiant/Irritant Gases

Any agent with displaces oxygen can cause death and are known asphyxiant gases. The patient dies of asphyxia from lack of oxygen.
Irritant gas irritates the respiratory system and can cause damage deep in the lungs. They also can act as an asphyixiant gas as well. An example of this would-be chlorine or phosgene.

Treatment:

Personal protection and removal from the exposure. Strip the patient off and sponge down with soap and water. For most patients simple removal from the exposure environment will be enough. They may feel short of breath and have a cough, but generally, removal is sufficient. For a small numbe, oxygen therapy is required to settle them down and for a smaller number still they will require respiratory support and potentially agents like albuterol/salbutamol if available. Fortunately for 99% of exposures, removal from the environment and basic respiratory support is all that is required.

Chapter 18: Medical Aspects of Shelter Living

While not everyone is planning on spending prolonged periods in a shelter, increasing numbers are, so for those that are there are 3 primary scenarios to consider (with varying likelihoods depending on your point of view):

- Nuclear conflict – resulting in the need to shelter for a limited period (a few days to several months).
- Massive planetary change (climate change, super volcano, comet strike) – resulting in the need to shelter for a more prolonged period (months to years).
- Somewhere to hide – this may be in response to collapse of society or the avoidance of other conflict or to avoid infected patients during a pandemic (again a few days to months).

While many might consider this unusual or extreme form of preparation, during one of the author's medical consulting work, the frequency of shelters as part of plans to manage the above scenarios has been increasingly common. It is also demonstrated by the proliferation of shelter builders or designers.

The medical aspects of shelter living is an area that for many is neglected – they just assume, that living in a small box for 3-6 months will be a minor inconvenience. It will be anything but. It will be a huge physiological and psychological burden.

One of the most useful points of references when considering the medical problems associated with shelter living is looking at the problems encountered in space, on submarines, or in the Antarctic. The similarities are obvious – enclosed space, cramped conditions, loss of privacy, potentially no natural light, same people day in and day out, and real or potential hazards. The people selected to work in these environments are carefully psychologically and physically screened and are trained to increased their psychological robustness, so it is not possible to make truly direct comparisons with a shelter group, but we feel it is still very worthwhile to examine the problems seen in those environments.

a. Mental Health Issues:

While psychiatry/mental health issues are addressed in the Mental Health chapter, there are some specific issues relating to shelter living we have addressed here:

1. **Isolation**. When selecting people for prolonged periods of isolation in small groups, a recurring theme is the introverted personalities with some extroverted traits. Repeated experience has shown that contrary to how you might initially think about it – introversion is better than extroversion. Being outgoing and good in group would seem vital to surviving in a small enclosed community. But that is not what introversion and extroversion is about – these are about where an individual derives their emotional energy from – themselves or from other. Being happy in your own company is a better trait than having to rely on others for your emotional energy.

While some people are natural extroverts, most people will have some introverted traits and if you are considering a shelter as part of your plans you need to culture your introverted traits.

2. **Boredom.** This is likely to be a major problem even for only a couple of weeks and a major problem long term; combating boredom is going to be a major issue. A deck of playing cards and a couple of old novels won't be enough.

   Research has shown that a human alone can only cope with 3 days of inactivity with limited stimulation before significant psychological distress occurs. This is seen in the form of loss of motivation, decline in intellectual activities (losing your edge), mood swings, and somatic complaints (headache, dizziness, nausea). The company of and interaction with others prolongs the period by several days. Several studies have shown that the average person needs 10-12 hours of activity per day to avoid boredom. Part of the answer is routine. Establishing a pattern, which occurs every day, is important for psychological well-being. People respond well to having a routine and having clear jobs to perform. Everyone should be given an area of responsibility and important activities that are theirs to perform.

   Books (not just non-fiction, fiction is equally important – escapism into a different world can be sanity preserving), craft supplies (especially for kids – but also for adults crafting has taken off over the last 10 years and many adults derive hours of pleasure "crafting"), and games (multiple packs of cards, board games, strategy games) are all vital to avoid boredom – catering to the range of ages which will be in the shelter. These are not a "nice to have", they are a "must have". Ensuring you have multiple activities is very important. IPad's and other tablets are useful as well – they require minimal electricity to charge them and 100's of hours of movies and 1000's of books can be stored on them.

   For children (and adults), structured teaching serves two purposes; it reduces boredom and provides the opportunity for education about survival topics and issues.

3. **Depression/low mood**. Low mood will be very common depending on the situation. Following any catastrophic disaster there will be an immense sense of loss; loss of family and friends, loss of possessions, loss of usual routine, and loss of lifestyle. This will be on top of a background of high levels of anxiety over immediate safety and security, and the future.

   For the majority, this will hopefully be relatively transient and be observed as a period of low mood and emotional lability. But they still retain the ability to function and, over time, improve simply with strong group support and encouragement. This sort of experience will be very common and entirely natural.

   Unfortunately, some will develop major depression. There is a formal diagnostic criterion for this but simply put, it means someone with severe low mood to the point they are no longer able to function in their work or personal relationships. It is characterized by a pervasive sense of hopelessness, inability to concentrate, poor or excessive sleep, poor or excessive eating, and a loss of ability to enjoy things in life. Its management in a survival situation may be difficult. Its usual management is social support combined with supportive psychotherapy and/or the use of antidepressant medications. The majority recover over 3-6 months - some sooner and some considerably longer.

In an austere situation, the most useful therapy will be strong social support. It is worth considering storing a supply of anti-depressants – especially one of the newer types such as selective serotonin re-uptake inhibitor (SSRI), the most widely known being fluoxetine (Prozac) or an herbal alternative such as St. John's Wort. If someone is completely incapacitated or suicidal with major depression this may force some hard decisions on your group.

The above comments apply to any major disaster situation and are equally applicable to survivors not in a shelter environment.

4. **Anxiety/Panic/PTSD.** It is reasonable to assume that some people may be so traumatized by their experience that they are unable to function, or worse still, they may be causing serious disruption to the other occupants. In stressful situations, it is perfectly normal to feel panicky, anxious, or worried about things. The greater the magnitude of the disruption the more intense the feelings. It only becomes a problem when it interferes with their ability to function. For most people simple one-on-one counselling, reassurance, and the passage of time will be sufficient but for others it may not. You should consider your response if this situation does occur. Options include physical restraint, chemical relaxation or restraint (using psychotropic medication such as Haloperidol or Midazolam), or in a worst-case scenario where the patient is unmanageable – expulsion. It is one thing dealing with this behavior in a random stranger you are dealing with as a patient – it is quite another when it is a family member or friend. There are several sobering books written by people with PTSD or their families and it doesn't lend itself to being managed in a shelter environment – it would be a massive and destructive force within closed unit. It is always best to consider how you would approach a situation like this, in advanced if possible.

5. **Sexual issues**. The issue of sexual tension also needs to be considered. The significance of this problem will vary depending on the structure of your group and the time you need to spend in a shelter environment. While you may dismiss this as not a problem for your group (and for a small family group it probably isn't), please consider the following: If you confine male and females over puberty together (particularly younger adults) and subject them to large amounts of physical and psychological stress, then sexual tension will develop, and sexual activity may occur; not necessarily between previously identified couples. This is a recurring theme throughout history; there is a high likelihood this will happen.

   For many, for religious and moral reasons, this is unpalatable, but it has been demonstrated time and time again, and you need to give some thought to how you would manage it. Your solution may vary from segregation of the sexes to condoning the activity but please don't pretend that this won't happen. Whatever you do it must be consistent in managing the overall mental health and moral of the shelter – so will depend on the composition and social structure of the shelter. Depending on your approach to this it may be appropriate to store condoms and the oral contraceptive as well.

6. **Privacy.** Loss of privacy has consistently been shown to contribute to psychological distress. Privacy is very important and becomes more important the longer you are confined. Allowing for an area in the shelter, if possible, which is partitioned off from the main living area where people can go to be completely alone and know they won't be disturbed will have a positive impact on mental health. Having the ability to have some "timeout" and privacy from cramped living conditions and other people will significantly reduce personal stress levels.

"Noise" privacy is also an important concept. Constant background noise particularly in a stressful situation can be a cause of friction and anxiety. This will be a major problem with young children particularly crying babies. Controlling their boredom can control older children's noise. However, having a small baby crying for hours each day in a confined area will be extremely stressful. Consider options of a "quiet room/space" with extra insulation, or earplugs, or muffs.

7. **Compatibility problems**. While not strictly a psychological problem, incompatibility problems between people in a shelter may become a major problem. Small groups form because of common goals and commitment. But a good relationship pre-disaster does not guarantee a good relationship post-disaster. There is no way to completely avoid this potential problem.

   Have practice runs – can you still talk to this person after being locked in a shelter with them for 72 hours? Unfortunately, often the first 10-14 days are relatively smooth – it is after that time that problems can arise. For those with a relative autocratic management style, please be aware that while someone in authority is important for making the difficult decisions and having ultimate control, studies have repeatedly shown that peoples' psychological well-being (or morale if you prefer) improves rapidly when they are given an element of control over their lives. Giving individuals absolute control over what they do is not practical in a small group survival situation, but allowing some degree of control for individuals will improve your group's functioning and well-being.

8. **Managing anger**. One of the reflex responses to stressful situation is to become angry -especially if things are not evolving as you think they should. Anger is the feeling and the physical form the anger takes is known as aggression. Understanding this and learning to control it is vital. Anger management classes have become a bit clichéd – its where nasty brutal people get sent by the courts – but there is value to the basic concepts driving it – you can control anger and modify your responses and lessen aggression.

   - Focus on the task – try and ignore perceived provocation and focus on completing a task. Try and be flexible in how to achieve a task – there are many ways to achieve the same thing and being flexible will lessen stress and anger. Continuing to focus on a task with flexibility can de-escalate a conflict.

   - Learn your own mental and physical cues that flag you are getting angry and beginning to show aggression. Recognizing that you are beginning to "wind up" is the first step on controlling it.

   - Develop a feeling of control over your situation – in a crisis this can be hard – but maintaining a sense of control is important to controlling anger and aggression.

"The good neighbor" concept:

While this section summarizes many of different issues associated with living long-term in a confined space, it can really all be boiled down to a very simple concept – be a good neighbor. Taking everything else aside think about what that phrase means. What are the features and behaviors that make someone a good neighbor. Think about neighbors, rooms mates, flat mates and friends – people you currently

associate and live with. These are the traits you want to present and encourage in others, in a small, confined, closed community, it may make the difference between survival or not.

Since most shelters will probably be based around family groups or close friends, many of these issues may not arise and there will be a lot of support but it is important to have thought about them, if there are any preparations you need to make, and what you would do to manage them if they arose

b. Space:

While in part having, personal space is for privacy (discussed above), it is for more than that. In anything more than a short term (weeks to a couple of months) situation individuals or couples/families need space to themselves. It doesn't have to be a big space, but research has consistently shown that having ownership of a small piece of space – to decorate, to keep personal trinkets and just escape to and be alone is vital. The submarine fleet has demonstrated this nicely with a piece of research looking at the concept of 'hot bunking' – that is sailors sharing a bunk. The larger more modern submarines have the ability for each sailor to have their own bunk – although a pretty small space, it is still their own private space – they can put up photos, they can store little items in the space. They can leave their belongings out to a degree without having to pack it up every 8 hours. They have shown consistently better mental health in those sailors who have their own space vs those who need to hot bunk. So, space is important – but it doesn't have to be a big space to provide a mental health benefit.

c. Infectious Disease:

In a confined environment, an outbreak of an infectious disease could be a disaster. Once you are established in a shelter the introduction of new bacteria or viruses is unlikely. Despite this, outbreaks of infectious disease in submarines still occur after the incubation period for infections have passed. It is likely to occur due to two processes. First, from mutation of bacteria already in the body to a slightly different form, that is different enough to cause new infections. Second, by contamination of the environment with bacteria and virus which normally live in the gut. Prevention of the first is very difficult in a confined environment. Prevention of the second can be achieved with fastidious attention to hygiene, particularly with hand washing and food preparation. Disinfectant hand-gels are very useful in situations where water may be rationed - but washing your hands with soap and running water is better than using an alcohol gel.

If you are likely to be in a shelter for the short-term, you should consider using completely disposable plates and cutlery. One of the biggest sources of gut infections in primitive situations is the inability to adequately clean plates and cooking utensils. If you are planning for long-term shelter living you must ensure that the ability to hot-wash your dishes with detergent is a priority – cold water washes even with detergent does not adequately clean plates and pans – beads of fats and remnants of food remain, which can act as a focus for bacterial growth.

There is no clear evidence that daily wiping down of all surfaces with a dilute disinfectant reduces infection. Despite this it is a common submarine practice (those who remain undersea for months at a time) in some countries navies and there medical braches have a strong believe that it reduces infections – and it is a relatively simple process.

d. Light:

Light is important for several reasons. Day-Night cycling is important in maintaining a circadian rhythm. Loss of a predictable light/dark patterns leads to sleep disturbance causing somatic symptoms (headaches, aches and pains), increased stress, reduced ability to concentrate, mood swings, and erratic behavior. Shelter lighting should be set to follow a day-night cycle with a predictable length. Over prolonged periods the pattern should be adjusted to shortening and lengthening of the light time to simulate changing seasons. This pattern appears to be relatively hardwired into our behavior.

Light is also required for the activation of vitamin D which is required for proper bone growth. In the absence of exposure to sunlight or due to dietary deficiency adults develop osteomalacia (thin bones prone to fractures) and children develop Rickets which is characterized by weakness, bowing of the legs, and deformities of other bones. White light is not sufficient for this process to occur, and full spectrum (primarily UV) light is required. From a dietary point of view, vitamin D is found primarily in fish oils and egg yolk. Supplementation with multivitamins (or separate fish oil tablets) is probably the best option for long-term shelter dwellers.

e. Exercise:

Exercise is important for both physical and psychological health. In the face of confinement and limited activity, physical condition rapidly decays.

Space is likely to be at a premium in most shelter environments. If it is at all possible, give some consideration to the value of storing small items of exercise equipment such as a mini-tramp or some sort of stepping device to provide the ability to undertake some form of aerobic or cardiovascular exercise. One possible option is using an exercise bike to run an alternator producing electricity to charge batteries or directly powering the shelter ventilation fans. Killing two birds with one stone, serving a very useful survival purpose while providing aerobic exercise. Depending on the physical shape of the shelter other options for aerobic exercise include skipping or sprint starts against resistance (such as a bungy). Anaerobic exercise is much for easier to perform with limited space using free weights, press-ups, and chin-ups, etc.

Exercise also provides an important activity of relief from boredom. It should be built into the daily timetable as a scheduled activity and should be compulsory.

The importance of exercise must be balanced against the energy expended undertaking it. This is particularly important in the face of limited food resources. If calorie restriction is in place then exercise should be limited

f. Nutrition

In the first edition of this book we made the following statement: “The excellent book “The Prudent Pantry” by Alan T Hagan is probably the bible for food storage programs and we strongly recommend it or the associated Food Storage FAQ when looking at nutrition for preparedness planning:

http://survivalistbooks.com/faqv4/ (link working 12/17)

After this, many books have been published on food storage, nutrition, and the "prepper" movement has become much more mainstream, several useful references are listed in the references chapter.

The key point relating to nutrition in a shelter environment is that relying entirely on stored food will be significantly deficient in several areas and, if un-supplemented, will prove fatal.

If you are relying on a very simple food storage program with only the core staples then you will have problems quickly. If you have stored a broad range of items, and tinned, and bottled foods in addition to dry staples then it will be less of a problem. If you are in the former group as an absolute minimum you should ensure that you have an adequate supply of multivitamin supplements

If you are planning long-term shelter living, you should give serious thought to developing a system for gardening within your shelter. Hydroponics is the obvious solution and can be relatively easily growing in a shelter type environment, however, crops still requires large amounts of light, water, and nutrients to grow.

A simple but limited solution to the problem is sprouting seeds. This is straightforward – it requires warmth and a full spectrum light source. The nutrient value depends on the type of bean used, how long it can grow, and the amount of light it is exposed to. The lighter and the longer the growth period the more vitamin A and C will be present with peak levels present at 8 days. Unfortunately, the peak palatability for these sprouts is 3-5 days.

In uncooked legumes (beans, peas, lentils) an enzyme which blocks the absorption of protein, is present. This enzyme is broken down with brief cooking. (Ref. The Prudent Pantry, A T Hagan, 1999 – now out of print).

Another important aspect to food storage for shelter living is variety and treats:

Variety – can you imagine eating nothing but the "Mormon 4" and a handful of sprouts a day for 12 months? Wheat, milk, sugar, salt and some oil? It can be done – people have lived on a restricted diet since the dawn of time – so it is possible. But it is a miserable existence and nutritionally sub-optimal. Every item of variety you can add to your long-term diet will improve your sanity. Even limited expansion to include a variety of grains – rice and oats in addition to wheat alone and the addition of several varieties of beans. Swapping the sugar for instant juice or jelly mixes. All of this is common sense and most people have planned for this. However, we continue to encounter people who have stored a year’s worth of the "Mormon 4" with very little else – they currently eat a huge variety of food and eat out in numerous different ethnic restaurants regularly – yet think they will be able to exist on a very abbreviated and monotonous diet.

Treats – This is really a continuation from the need for variety discussed above, the addition of simple treats may well be lifesaving. Tea, coffee, chocolate, boiled sweets – what is a treat will vary from person to person. But their presence will potentially make the difference between survival or not in a confined space for a prolonged period. Consider things like birthday boxes and boxes for Christmas or Thanksgiving – for these special occasions, have little stashes of chocolate, a can of peaches or of ham. The morale boost of little things like this cannot be underestimated.

Chapter 19: Austere Mental Health Care

Many areas in this book offer how-to advice, guidance and direction. However, owing to the complexity of mental health this chapter will only offer a general overview and some modest suggestions for basic treatment with simple medications where appropriate. What it does not offer is instruction in providing the most practical treatment of all for the austere and otherwise limited resource setting – that is counseling and related therapy. For that we refer you to the References Chapter for the listings for **Where There Is No Psychiatrist, Where There Is No Child Psychiatrist** and **Basic Counseling Techniques**.

Mental illness has been widely misunderstood and even more poorly treated throughout history. This is in part because of a lack of understanding as to what constitutes "illness" versus outside influences that may range from temporary stress reactions in an otherwise mentally healthy individual to a flare in an established mental illness. In between are various ailments that range from mild to severe, including so-called social disorders (anxiety, phobias, and various mood disorders), bipolar disorder (also referred to as manic-depression) schizophrenia and more.

Most mental illnesses can be treated to varying degrees, but none can be cured as such. Instead the term used is "remission", which is an absence of whatever disease or illness is affecting the person, whether mental or physical. Sometimes the remission is complete, with the illness never to return. Remission can also be temporary or repetitive. In other words, the patient may return to their previous state of illness and remain there. They may also recover, fall ill again, recover once more, and so forth. Once a remission is achieved, there is no way to predict when or if the signs of illness will return. The degree of successful treatment will vary widely in the austere setting, just as it does with a fully functioning modern healthcare system.

Depending on the situation you encounter that is otherwise spoken of in this book as being a "grid down event", you may have to attempt treatment, tolerate the individual, or resort to age-old remedies that may include physical restraint (when needed), locking them up for the safety of themselves and/or the community, or even outright banishment. There is no one-size-fits-all response even in the fully functioning modern world, and a time of serious disruption will be no different.

The incidence of mental illness of any type in adults in the United States (chosen as a representative country only; actual incidence will vary widely around the world between countries and cultures) is generally believed to affect around 18% of the population in any given year. This includes short-term problems such as situational depressive episodes and anxiety problems that may resolve with time, to long-term or permanent illnesses such as Post-Traumatic Stress Disorder (PTSD) and bipolar disorders.

In the "grid down" world a significant increase in mental disturbances is all but certain, but many times these will be of the treatable variety. Keep in mind that mental illness is just that: an illness. The affected individual may have little to no control over their symptoms.

Assuming the person does not have a preexisting diagnosis of mental illness, what you are facing might be the result of the patient's inability to adapt to the new reality of an altered society. In such an event, it is important that you first identify the existence of an apparent breakdown in their thinking, actions or reactions, versus how they normally behave.

This could be something as simple as increasing disinterest in common things such as eating, being around others or engaging in activities they previously took interest in, or any number of the usual everyday activities of life. This could indicate the onset of depression, or merely an Adjustment Disorder.

On the other hand, they could become increasingly convinced that the change in circumstance gives credence to their previously held, but otherwise not openly expressed, convictions that "someone" is out to get them, and has arranged an elaborate societal collapse as a means of getting at them. In their mind this all makes sense, and they offer what to them are valid reasons for their suspicions. This would be an example of Paranoid Schizophrenia.

Both above examples illustrate problems that could be brought on by a severe disruption in our modern society.

1. Potentially Treatable Mental Illnesses

Examples of those that may be successfully managed to different degrees - varying from a complete ending of all symptoms (full remission) - to functional in daily life may include:

- Depression
- Anxiety, including Post-Traumatic Stress Disorder (PTSD)
- Social Phobias
- Some Addictions:
    - Methamphetamine
    - Opioids
    - Nicotine
    - Alcohol
- Grief Reactions
- Stress Response Syndrome
- Attention Deficit [Hyperactive] Disorder (ADD/ADHD)

Austere Recognition and Treatment

Depression:

Depression is a disorder characterized by persistently low moods and/or feelings of hopelessness. The actual term applies more towards the deeper end of the spectrum, rather than the lesser states of depression such as Adjustment Disorders or Grief. Depression can also be caused by environmental factors (Seasonal Affective Disorder, which is normally a winter-time occurrence).

Symptoms of depression may include:

- Feelings of worthlessness.
- Persistent lack of appetite.
- Ongoing sleeping problems (too little, too much, or infrequent).

- Lack of interest in life, even with things that used to bring joy.
- Profound sadness.
- Moodiness.

In severe cases, the person may express a longing to die even if it means suicide. A key point here is determining if they have a plan to achieve this goal, or if it is merely a thought versus an actual goal they might intend to be working towards.

Simple treatments include:

Exercise – regular exercise can be as effective in treating depression as medication, by boosting endorphins, serotonin and other brain chemicals that cause us to feel good. As little as 30 minutes of aerobic exercise per day can produce noticeable results. 60 minutes daily is even better.

Lifestyle changes – in a true long-duration disaster scenario this is easier said than done, but it is not without possibility. Think in terms of gardening, cooking, sewing, or other activities that provide diversion and which may contribute significantly to the well-being of others, and by extension make the patient feel better about themselves.

Herbal remedies – Saint John's Wort is often touted as a natural anti-depressant, but confirmable data is hard to come by. There is a study completed in 2016 (Beijing, China - Cui YH, Zheng Y) that concluded that St. John's wort extract can be almost equally effective in treating minor to moderate depression as the traditional medications usually prescribed (Selective Serotonin Reuptake Inhibitors, or SSRIs), and that the results exceed simple placebo effect. Note that it is not effective in severe cases.

Counseling - Cognitive Therapy is intended to help the depressed person to identify their illness, and possible causes (if not strictly organic in nature), and steps they can take to manage their symptoms. They can also benefit from having a sympathetic listener available when needed.

Anxiety:

Nervousness or mild fear combined with anticipation is a normal part of life. It becomes a mental health issue when it is constant, overwhelming and irrational. It can rise to a level that it is literally crippling, interfering with normal life functions. It is important to know that the presence of an anxiety disorder is not an indication of weakness or a flaw in a person's character but rather the result of a combination of factors that may include actual changes within the brain itself and environmental factors such as unrelenting stress or physical duress.
Anxiety disorder existing prior to "The Event" (insert your favorite scenario here) is more likely to be organic in nature than newly emerging anxiety issues in persons within your family, group or community. Anxiety after "The Event" may be a typical response to overwhelming changes in one's life. Only time will tell if the changes in their mood and demeanor will be a permanent part of their life, or if they can learn to adjust, adapt and accept.

Simple treatments include:

Diversion – find activities and duties that focus the person's attention away from the changes that are causing their fears. Whether working or playing, activity requires attention and concentration, leaving

less time for the person to dwell on their changed situation. Reading, playing games, or focusing their attention on someone else who is in need of physical care can all be beneficial.

Lifestyle changes – avoiding alcohol, caffeine and tobacco can improve anxiety. Getting better sleep is very important as well.

Medication – simple medications may be administered to help manage the more severe symptoms of anxiety.

- Benadryl
- Inderal

Alternative remedies may also be used. Anecdotal evidence and limited medical studies suggest Valerian and Passion Flower may have valid uses for treating anxiety.

Post-Traumatic Stress Disorder (PTSD):

A form of mental illness that can develop in persons exposed to a seriously traumatic (life-threatening) event such as combat, a vehicle accident or a very serious grid-down event. It is generally classified as either an anxiety or stressor disorder. The causative event would have exposed the affected individual to significant fear, helplessness or physical danger – it is not always singular, it can be cumulative. The person affected may attempt to avoid certain cues that remind them of the originating event. It may affect the way the person thinks and feels about themselves. It may be considered to be present if the symptoms (nightmares, flashbacks, overwhelming feelings of helplessness that impair action, very conscious avoidance of event reminders, the need for silence, irrational anger) persist longer than a month after onset of symptoms.

Treatment: These are much the same as for Anxiety Disorder, with counseling and sometimes the addition of simple medications to help the person deal with ongoing problems. Counseling in the form of cognitive therapy is most often used, along with another process known as exposure therapy.
Basic Counseling Techniques are useful and simple medications which can be used to manage disabling PTSD include:

- Prazosin
- Propranalol (Inderal) – benefit has not been firmly established but some research has indicated that it may be beneficial.

Social Phobias:

Also, commonly referred to as Social Anxiety. Though most likely a pre-existing condition, severe changes in the environment can cause it to surface in some cases. It is characterized by fear of interacting with others – commonly crowds of people but sometimes even as few as one or two people. In the past, such people might have been referred to as "loners" who tend to keep to their own company. It tends to be pervasive, affecting all aspects of the person's life, and chronic – it does not tend to go away on its own.

Symptoms include isolation from others, avoiding interaction with others, being easily embarrassed, avoiding eye contact and feeling insecure in the presence of others. There is no one defining symptoms but rather a range of symptoms considered together.

The only effective treatment is cognitive behavioral therapy. Simple medications can help control some of the symptoms on a temporary basis only and do not work for ongoing treatment.

Medications: Propranalol (Inderal) - limited to short-term use prior to known trigger events such as public appearances

Addictions:

Addiction is a physical or psychological dependency on a substance such as methamphetamine, opioids (whether so-called "street drugs" like heroin or cocaine, or prescribed medications such as morphine, Oxycodone or Hydrocodone), nicotine (tobacco) or alcohol.

Many times – but not always – the psychological dependency is stronger than the actual physical addiction. Even after the person is completely detoxified from the physical effects, the mental craving can persist, even for a lifetime in some instances. The only long-term treatment is avoidance once the person is "clean", though in the case of medications for legitimate purposes, very careful and closely monitored administration may be allowed provided it is ended as soon as clinically practical and no further access to the medications is allowed.

Key point: Though there are many treatments available depending on the substance being abused, only completely abstaining from the addictive agent is ultimately effective, although changes in personality brought on by the long-term use of the substances being abused may remain for the remainder of their life.
Before reaching this point, the person may experience profound symptoms of withdrawal as the body makes known its demands for more of the substance it has grown used to. Withdrawal from any of the above groups of substances is unpleasant to varying degrees, but it can be done even in the austere environment. The person in withdrawal will require a great deal of support combined with counseling while their body adjusts to the new changes.

Of the above-named substance groups, only alcohol normally presents the possibility of life-threatening withdrawal symptoms through a process known as delirium tremens, which are characterized by confusion, rapid heartbeat and fever, and possibly seizures. The death rate from this can approach 1 in 20 people so affected. Treatment consists of benzodiazipines such as Librium or Ativan administered on schedule over several days, and supportive care until they are past the acute withdrawal period.

Grief Reactions:

Grief reactions are a complex set of physical symptoms that may occur with extreme sorrow, most commonly in conjunction with the loss of a loved one such as a spouse or other family member. It is not unreasonable to expect that for some people a drastic breakdown on society can also bring on an extreme grief-like reaction as a response to the loss of a normal life.

Symptoms may include:

- Tightness in the throat or chest.
- Shortness of breath.
- Stomach problems such as pain or diarrhea.

- Extreme tiredness.
- Muscle weakness.
- The person may also exhibit anger, guilt, inability to concentrate or extreme restlessness.

Onset of symptoms may be immediate or delayed. Most cases last no more than 1-2 months, although it can last much longer and devolve into morbid reactions that can cause psychosomatic illnesses such as ulcers or asthma. In such instances, more aggressive intervention may be required to help the affected person work through the grief, as well as treatment of the physical symptoms.

Treatment is supportive, focusing on counseling, and possibly mild sleep aids such as Benadryl or Melatonin.

Stress Response Syndrome:

Previously known as adjustment disorder, this is a temporary condition that can occur when a person has trouble adapting to a significant change in their life, such as the ending of a relationship or marriage, loss of employment, significant illness (yourself or a person close to you), or living through a disaster such as fire, flood, or "The Event".

The reaction is greater than might normally be expected to the stressor, but falls below that of serious impairment. It is not the same as PTSD in that the event was not life-threatening and the duration of the syndrome is shorter and less adverse.

Symptoms may include several of the following:

- Feelings of hopelessness.
- Sadness.
- Frequent crying.
- Unusual tiredness.
- Sleep disturbances.
- Worry.
- Upset stomach.
- Changes in work attendance.
- Changes in behaviour such as uncharacteristic aggression or reckless driving .

Incidence of this syndrome is very common and affects both genders almost equally though it may present differently, i.e. crying versus aggression. Treatment involves counseling, remission is very likely, such that recurrence is generally not expected.

Attention Deficit Hyperactive Disorder (ADHD):

Previously also called Attention Deficit Disorder.

- Normally begins in childhood before the age of 12 years.
- Continues into adulthood in most instances, though the subject can learn to manage the symptoms with growing maturity.

Characterized by:

- Being easily distracted.
- Forgetfulness.
- Disorganization.
- Avoiding tasks that require long periods of focused attention, such as homework.
- May talk excessively.
- Tends to interrupt others.

Adults may exhibit increased tendency towards:

- Anxiety.
- Depression.
- Mood swings.
- Procrastination.
- Impulsiveness.
- Anger control.

There are no commonly available non-prescription medications for treating ADHD, though melatonin is used in children to aid with falling asleep.

Treatment for adults consists of:

- Cognitive and behavioral therapy.
- Relaxation training and stress management.
- Some people may benefit from Benadryl during acute periods of excitability, while in others it will actually make the symptoms worse.
- Avoidance of drugs, alcohol and tobacco can reduce symptoms.

Treatment of children: see **Where There Is No Child Psychiatrist** in the References chapter.

Dietary treatment: some clinicians believe that a so-called ADHD Diet consisting of high proteins, few simple carbs and increased complex carbohydrates and increased intake of Omega-3 fatty acids can be beneficial in both children and adults.

2. Less Treatable Illnesses

These conditions (which are defined later in this chapter) are such that austere management is not likely beyond individual case-by-case management. If the person is known to be diagnosed with one or more of the following disorders, arranging to maintain their access to prescribed medications shown to be useful in their case is key – and should be a priority.

Medication treatment for these particular disorders is highly individualized and usually determined only after long experience with the individual, and trial and error prescribing. Random stocking of psychiatric medication to treat these conditions is unfessible.

- Antisocial Personality Disorder.
- Schizophrenia and its variants.
- Bipolar Disorder (Manic Depressive).
- Obsessive Compulsive Disorder.
- Paranoid Personality Disorder

3. Definitions:

Mental health and Psychiatry are complicated and have their own associated language – what we have tried to do here is provide definitions for some common disorders (we haven't covered already) and terms associated with treatment and drugs.

i. Anticholinergic

A category of medications (example: Atropine) that blocks the receptor sites for a type of nerve impulse (parasympathetic system). Many medications have some anticholinergic activity as an effect to varying degrees, including Benadryl, Immodium, Tagamet, Robaxin, Ultram and numerous others.
Anticholinergic effects can be desirable or not depending on the intended use for the medication.

ii. Antisocial Personality Disorder (Sociopathy)

Simply stated it is a mental disorder characterized by a disregard for the rights and property of others. In layman's terms the person is a "sociopath".
Those affected have a genuine lack of remorse or guilt feelings. They are often incapable of fulfilling responsibilities to family, jobs, and society in general. They may frequently be in trouble with the law, and tend to behave impulsively - and even aggressively - and since they lack a sense of guilt, frequently lie to others on a regular, ongoing basis. They will disregard or otherwise fail to learn from any negative consequences of their behaviours. They fail to adapt to social and ethical standards considered to be the norms of society. The condition may manifest during the teen years but tends to become fully developed in the 20's and 30's. It is thought to be a lifelong condition. It is very difficult to treat even with a fully functioning healthcare system.

iii. Bipolar Disorder

Characterized by exaggerated mood shifts between "highs" (manic phase) and "lows" (depressive stage) that differ widely from the normal ups and downs most people experience. Substance abuse also tends to occur in people with this condition at a higher rate than experienced by the population in general. Bipolar Disorder tends to start in the late teens and after, with approximately 1/2 of all cases developing by age 25. It is thought to be a lifelong condition, and it can worsen with age. The seriousness of the illness can vary widely between individuals. Substance abuse also tends to be more common in people with this illness.

iv. Borderline Personality Disorder

A very serious psychiatric illness characterized by frequent ongoing mood instability, relationship problems with peers, impaired self-image and a strong tendency towards risky behaviors and suicidal thoughts and actions. As many as 2 percent of adults are affected by this disorder. It peaks in young adulthood, and fortunately tends to decrease in intensity as the person ages. Mood changes tend to be sudden and dramatic, and rather than seek isolation from others, they may exhibit an intense need to be around others.

The causes of this disorder are thought to be a combination of genetics and environment, with a very high percentage reporting past histories of physical and sexual abuse (primarily rape). It frequently occurs in combination with other problems such as bipolar disorder, anxiety and depressive disorders and substance abuse. With appropriate treatment (mood stabilizing drugs and intensive therapy) many can improve over time and lead stabile lives.

v. Cognitive Therapy/Cognitive Behavioural Therapy (CBT)

Cognitive therapy is a form of psychotherapy that is commonly used to treat depression, anxiety and other mental disorders. It may be used alone or in combination with medications. It is not difficult to learn but requires significant amounts of practice to become truly good at it, although some people are by their nature better at it than others.
The goal of cognitive therapy is to identify and replace the disordered thoughts and feelings with those that are more beneficial. Essentially the focus is on replacing irrational negative thoughts with rational constructive ones and helping to train the person to identify when the negative thoughts are coming into play and select more appropriate ones, and teaching strategies to cope. It does not provide quick relief but instead takes place over a period of many weeks, months or even years. It can also be beneficial for certain physical maladies such as pain or insomnia.

vi. Exposure Therapy

A technique that involves exposing the individual to the object or memory causing distress but in a non-threatening manner. The technique is used repetitively until the patient learns to control their fear. It is commonly used to treat various anxieties, obsessive-compulsive disorder and PTSD.

vii. Extrapyramidal Symptoms/Syndrome (EPS)

Drug induced movement disorders that may affect the face, back, neck, tongue and others. They can also exhibit as a shuffling (foot-sliding) gait or increased salivation (drooling).
They can be divided into various sub-categories such as:

- Acute dystonic reactions – spasms of the muscles affecting the jaw, neck, tongue, throat and back. Most frequently occurs in younger males.
- Akathesia – an internal feeling of anxiety, nervousness or tension characterized by an inability to sit, stand still or remain otherwise inactive.
- Tardive Diskenesia – involuntary movements of the lower face (jaw, tongue) and the arms and legs. It is a chronic condition caused by long-term use of antipsychotic medications.

A simple medication known as Cogentin is used to treat the side effects such as the above that can be caused by long-term of various psych meds.

viii. Grief Reaction

The response to the loss of someone or something (pet, house, etc) close to or of great importance to you. It is very common and normally resolves to a manageable level in time, but can for some people rise to a degree that is incapacitating, and which may affect them for the rest of their lives.
Typical symptoms may include feelings of emptiness or fatigue, confusion, anger, guilt or relief. The symptoms may be delayed until some milestone or task is completed, or may occur immediately. They may persist for weeks or even a few months, and generally resolve with time.
Complicated Grief: Not considered to be normal grieving but rather a very prolonged period of grieving (in excess of 6 months) that may also manifest with physical symptoms that include breathing problems and/or stomach issues, chest pains, "giving up" on life, and significant depression.

ix. Interactions

Interactions are effects caused by the mixing of some medications within the body. They can be either desirable or undesirable. An example of the first would be the use of Phenergan with morphine to potentiate (enhance) the effects of the pain medication. In the second instance using Benadryl for someone also taking a Potassium supplement can easily lead to increased risk for bleeding from the stomach, a highly undesirable effect.

x. Normalcy/Normality Bias

Rather than a true mental illness, it is better classified as a state of denial. Simply stated, it is a refusal to accept the reality of what is happening around the affected person.
Life has always been good and predictable from their point of view, and this nonsense about a "grid down" situation is just that: nonsense. Other people are overreacting, they will say. Everything will return to normal very soon, they might insist.
Our minds are capable of many things, and one of them, for better or worse, is the ability to refuse to accept sudden, severe changes in the world around us. It is a protective mechanism which shields the mind from what might otherwise become an overwhelming new reality. It is one reason bystanders at a horrific accident scene may "freeze" rather than either run away or try to lend aid. Their mind simply will not accept that what they are seeing is real.
In the event of natural disaster, for instance, the person may refuse to leave their home to a place of safety. Or they might refuse offered aid because to accept would, in their mind, be accepting that things actually are different now and may not return to normal any time soon. Normalcy bias has resulted in countless deaths throughout history because people refuse to accept that things are different.

xi. Paranoia

An ongoing and uncontrolled suspicion that others are watching, plotting and acting against the individual, without a basis in reality. It can range from reasoned caution to unreasonable suspicion; it can

rise to a debilitating level that governs a person's everyday life and interferes with their ability to fully interact in a rational manner with others.

xii. Psychosis

Psychosis is an abnormal perception of stimulus and a loss of contact with reality. It can occur as a one-off episode (as a consequence of sleep depreviation, exposure to psychological trauma, drug abuse or as stand-alone mental illness) or recurrent – recurrent psychosis is generally known as schizophrenia – although is also seen in bipolar disorder or severe depression. A single episode is fortunately most common.

The diagnostic criteria are very variable and complex, but the basics of this diagnosis is the loss of touch with reality. A common feature is hallucinations – auditory (sound) and or visual (seen).

Dealing with someone who is psychotic can be very distressing to carers. It is also very disabling to the patient. The basic management of psychosis is aimed at calming the patients and frequently tethering them back to reality. Problems arise in an austere situation when the main elements are paranoia or aggression.

Most episodes are self-limiting and can be managed with support and minimising the stimulus which lead to the psychosis – drugs, alcohol, stress. Sedation may be useful in the short-term with benzodiazepine such as diazepam (Valium).

Recurrent or persistent psychosis is much more of a clinical problem. Historically "madness" or "insanity" wasn't uncommon and while this was a catch-all for a lot of mental illnesses a number would have been psychotic patients.

Dangerous paranoid people: These people are currently treated with medication (anti-psychotics) and on some occasions they require treatment in a hospital. Sadly there are limited options in an austere situation. The only real options are to confine or expel the person. Insane asylums prior to 1970's (and going back to Egyptian times) have a fascinating history – but this is probably not the right forum. Sadly if you had essentially unmanageable behaviour, you got locked up.

xiii. Psychotherapy

There are various "schools" of psychotherapy and they all have slightly (sometimes radically) different approaches – but all are focused counselling. They basically allow the patient to talk through problems with a supportive, sympathetic listener who may suggest some methods to cope or point out irrational thought processes and help accept any damaging rational thoughts.

Psychotherapy broadly isn't overly complicated. But it does need a good communicator and is also time-consuming. You will need to allow significant time for this form of therapy but it is possible in a survival situation. We think this form of therapy is very valuable in a austere or survival situation.

xiv. Tachycardia

Elevated or fast heartbeat over 100 beats per minute. It may be completely unrelated to the mental illness and its treatment, or a symptom of elevated mood, anxiety or stress. It can also be caused as a side effect of some medications used to treat mental illness. By itself it may not be of concern unless there is an underlying heart issue.

4. Potential Causes of Mental Illness:

It has already been stated but is worth mentioning again for emphasis: a grid-down situation can itself be the cause of the onset of mental illness in some people. It is not unreasonable for previously healthy people to react badly to the significant stresses of such an event; war, economic collapse, severe pandemic illness, a widespread breakdown in society – any of these could be the cause of a break in an otherwise mentally healthy person. The effect of overwhelming stress should not be discounted.

Other potential causes might include the effects of substance abuse. Alcohol, marijuana, the use of so-called 'street drugs' such as methamphetamine or cocaine, or even long-term use of prescription medications such as narcotic pain relievers can result in changes to the physical structure of a person's brain, making them more susceptible to developing a mental illness.

Marijuana has been frequently touted as a potential "medication" for treating depressive and bipolar disorders, among other ailments. However, scientific studies from as far back as 1969 (Sweden) up to the modern day have shown that even infrequent use can contribute significantly to the development of schizophrenia, particularly when the user is under 21 years of age. Some people also have a genetic tendency towards schizophrenia which may be increased as much as 600% in the face of early (teen years) use of marijuana.

5. Medications:

There are a few generic medications which are reasonably widely available that may be of use in the austere environment when attempting to address some forms of mental illness.

Diphenhydramine (trade name: Benadryl) is a must-have drug for the management of mental illness in the austere environment (and for austere and survival medicine generally).

- It is easy to acquire in quantity and various forms
- It is inexpensive
- It is useful for several purposes

Benadryl can be acquired in liquid, pill and capsule forms, and even injectable, and is a key ingredient in several medications such as Sominex, Nytol and other over-the-counter sleep aids very commonly found in the US and elsewhere. It possesses properties that make it useful for sedation (sleep inducing), countering the effects of other prescription medications taken to treat mental illness (extrapyramidal symptoms), reducing anxiety, and blunting the effect of severe mood swings.

It should be used with caution in people over 60 because of an increased half-life (up to 17 hours for blood levels to be reduced by ½) and in hyperactive children (where it may actually increase the symptoms). There is also evidence from one study that indicates that long-term regular use in older patients may contribute to the eventual development of dementia (JAMA Internal Medicine March 2015) because of Benadryl's anticholinergic effects.

Simultaneous use of Benadryl and medicines that also contain Benadryl should be avoided.
Benadryl is not considered to be habit forming save that some people will develop a psychological dependence on it ("If I don't get my Benadryl I won't be able to sleep") rather than an actual physical dependence.

Dosing:
Anxiety – 25-50 mg by mouth every 6-8 hours while awake as needed.
Extrapyramidal Symptoms (EPS) – 25-50 mg by mouth every 6-8 hours.
Insomnia – 25–50 mg at bedtime. Use with great caution in the elderly.
Mood Swings – 50 mg by mouth every 6 hours while awake. Use only during periods of over-elevated mood swing to avoid increased depression during low mood periods.
A competent drug reference should be consulted if the patient is also using other medications, as there are a few that Benadryl should not be used in combination with.

Propranolol (trade name: Inderal) is a beta-blocker medication; it affects both heart function and blood flow in the vessels throughout the body by slowing the heart and dilating the vessels, which has the added benefit of calming the user. In mental health medicine it is sometimes used to treat anxiety disorders, panic attacks, aggressive behavior, phobias, schizophrenia and bipolar disorder. [Source: Stanford School of Medicine, 2016] It may be of benefit in treating PTSD but this has not been firmly established. There also studies citing its effectiveness in reducing aggressive behavior in elderly dementia patients.
Possible drug interactions may occur if used simultaneously with Haldol (generic: haloperidol) which may cause a dangerous lowering of the blood pressure, and Tagamet (generic: cimetidine) which may lead to increased levels of propranolol in the bloodstream.

Dosing:
Aggression (elderly patient with dementia) – 40-120 mg dose taken orally 3 times daily. Start with the lowest dose and increase in 20 mg steps at a rate of not less than every 24 hours. Expect up to one week for best effects to show. [Journal of Alzheimer's Disease 04/2006]
Anxiety – limited to short-term use for social anxiety issues (also known as stage fright or performance anxiety). 10-40 mg is taken orally 30 minutes prior to the anticipated event. It has not been shown to be beneficial for general anxiety issues.

Trazadone (trade name: Desyrel) used to treat adults with major depressive disorders. It is classified as a hypnotic. It is also used to treat sleep disorders, dementia related repetitive screaming, and anxiety and panic attacks. It is also used to treat the insomnia and nightmares associated with PTSD. It is considered to be relatively safe and non-habit-forming. It is considered to be safe to use for people with sleep apnea as it does not depress breathing.

Dosing:
Depression – 150 mg daily taken in 3 divided doses of 50 mg each. May be increased by 75 mg a day every 3 days if needed (225 mg total beginning on day 4, 300 mg day 7, 375 mg day 10) if desired effect has not been reached. Maximum daily dose is 375 mg. Dosage may be gradually reduced after therapeutic effect has been reached. If the patient becomes sleepy the majority of the dose may be given at bedtime (1/3 morning, 2/3 nighttime).

Dementia (repetitive screaming and other nighttime symptoms) - 50 mg taken orally at bedtime is the usual dose, though 25 mg may be adequate for some cases, and 100 mg may be needed for others.

Insomnia – start with 25 mg. May increase to 50 mg if not effective. No more than 100 mg should be used to induce sleep. It is taken 30-60 minutes before bed time.

Prazosin – research suggests that this medication, normally used for blood pressure control, can aid reducing the nightmares and hyper-vigilance sometimes associated with severe PTSD.

Dosing:
There is no standard dose when used for this purpose. Reports indicate as little as 2 mg is beneficial for some, whereas others may require up to 40 mg. Determining what dose may be effective for a particular person will be a trial-and-error event. (EPA 2012: 20th European Congress of Psychiatry: Abstract P-1094. Presented March 6, 2012)

Hydroxizine (trade name: Vistaril) is an antihistamine sometimes used in adults as a sedative for treating anxiety and tension.

Dosing:

Usual Adult Dose of Vistaril for Anxiety:
Oral: 50 to 100 mg 4 times a day.
IM: 50 to 100 mg immediately, then every 4 to 6 hours as needed.

Uses:
Oral: Provides symptomatic relief of anxiety and tension associated with psychoneurosis; an adjunct treatment in organic disease states in which anxiety is manifested.
IM: Treatment for psychiatric and emotional emergencies, including acute alcoholism.

Melatonin is a hormone produced naturally by the body as a means of inducing sleep. Some people are naturally deficient in this hormone and may require supplemental use to achieve normal sleep patterns.

Dosing:
1.5 – 3.0 mg nightly for delayed sleep onset.
3-6 mg/night as a hypnotic.
It can be used for autism, ADD/ADHD and depression in children with difficulty sleeping. It is used in adults as a sleep aid.

Final Thoughts

Mental illness is pervasive in society around the world. Though not impossible, it remains very difficult to predict ahead of time who may be affected by serious psychiatric problems at some period in their life. Some people who appear in every aspect to be mentally stable can face a sudden stressor that completely overwhelms their mental defenses.

Other people may suffer from ongoing depression or other alterations in their thinking, and rise above them to face the new challenge.

Either way being prepared to deal with acute mental health issues is an important part of any post-apocalyptic disaster plan.

Chapter 20: Nursing Care in an Austere Environment

The most basic tenants of medical aid can be summarized into two phases:

1. Initial treatment, and
2. Follow-on care.

The other chapters of this book have covered initial treatment ranging from the simple to the extremely serious. They address the means of determining a working premise (presumed diagnosis) upon which we will base our care, and how to carry out those procedures by which we hope to reverse the effects of injury or acute illness. By contrast this chapter is devoted to follow-on medical aid and recovery, which we shall refer to hereafter as nursing care, the second phase of care as identified above.

Healing from illness and injury takes time; it is a process. Something as simple as a minor laceration takes days to heal, during which time the affected area may be sensitive to touch, pressure, temperature or changes in weather. Until it heals it may be prone to infection, might limit functionality or motion, and may require additional attention beyond the initial treatment phase to encourage proper healing.

Quite often, recovery from acute illness or notable injury takes weeks before the patient is back to their former state of health. It is normal for the patient to feel general weakness from which the recovery is slow. Some sicknesses or injuries may cause significant long-term disability that the patient has to factor into their daily activities. In other instances the long-term effects of an illness are slight, manifesting as no more than increased fatigues from which we slowly recover as we get back to our former selves. There are in reality, few illnesses from which we fully recover within a day or two.

In the ancient world, there were those who were widely regarded by their neighbors as healers. They knew how to reduce a fever that the body itself was unable to fix without outside aid. The healer had the intuition, if not the knowledge, needed to heal sprains and strains faster, or to cause wounds to close quicker and with less chance of infection. They exhibited uncommon skill at healing insults to the body long before there were formal training programs intended to pass along in organized fashion the skills of those whom we now refer to as physicians.

Today the healer of old might be referred to by any of numerous possible titles that are conferred depending upon their education. At the top of the medical care provider pyramid is the doctor/physician. Below them are a myriad of caregivers ranging from the basic first aid giver to the Physician Assistant or Nurse Practitioner in the US.

Austere nursing, as does austere medical care at any level, challenges us at a level we would ordinarily try very hard to avoid: that is, to provide the maximum benefit to our patients with a minimum of tools, supplies and assistance, all while working outside of our modern system of health care. In an age when we as healthcare consumers expect the latest and greatest in technology, education and chemistry to be immediately available, the purpose of this book is to pass along methods for doing exactly the opposite; we seek to instruct and inform others in the knowledge that will allow the austere care provider – whether physician, nurse or home first aider - to accomplish the maximum gain for their patient with the minimal tools they have available.

Even amidst the so-called modern era of healthcare, we occasionally encounter examples of austere care necessitated by circumstances beyond our control. The most recent and famous example is that of the aftermath of Hurricane Katrina and its effect on the American Gulf Coast region, notably the modern city of New Orleans. Isolated from the rest of the world by floodwaters and washed out roads and bridges, deprived of relief staff and replacement supplies for days, the caregivers nevertheless carried on as best as they were able.

For our purposes "nursing" refers to a type of care, i.e. ongoing day-to-day care as opposed to an occupational calling, which will be hereafter referred to as Nursing with a capital letter. Working from that basic definition it is correct to assume that the person(s) providing this care may not have formal training in modern Nursing theory and practice. The tools and supplies available to them may be rudimentary and short in quantity. Nevertheless, the goal is to provide for a large range of physical and emotional demands caused by the patient's illness or injury with an eye towards accomplishing the best recovery that can be made under less-than-ideal circumstances.

Recovery care begins where urgent or immediate care leaves off, once the patient is stabilized and any imminent threats or disabilities are addressed. Because the subject of nursing care per se is so vast, it is not the intent of the author to provide a complete how-to. This chapter is meant to introduce basic principles of austere follow-on care, highlighting some of the factors involved, the attendant duties, and offering suggestions and recommendations for carrying through in less-than-optimal environment. To be truly competent in the provision of austere nursing care, the reader – even if an experienced Nurse - must continue to study at every opportunity using every reasonably available resource, and practice such skills as they might until they become second nature.

You will need to be familiar with a large bag of tricks that will make recuperation not only more likely but also more bearable for patient and caregiver alike. Not everyone will survive despite your best efforts. Not infrequently whether someone recovers from a major trauma or significant illness depends on the care they receive beyond the emergent or acute phases. With prior planning, quick action and competent care provided from the outset the patient may not only survive but be well on the road to recovery from a fractured femur, for instance, only to succumb weeks or months later to the effects of being kept bedfast. Blood clots in the lower legs caused by inactivity, infected bedsores that result from lying in bed for too long, or even pneumonia resulting from the use of a simple anesthetic agent such as ether may claim them long after the fracture has been set and the road to recovery is being well traveled. Simple nursing measures can go a long way towards preventing any of these from occurring, or addressing them if they should.

On a more everyday basis there are also simple considerations to make austere nursing practical: how to properly assess a temperature using an old-fashioned mercury thermometer, how to administer a proper injection, reducing fever with simple measures when faced with a lack of proper medications, and ensuring proper nutritional support.

A. Defining Austere Nursing Practice:

Austere nursing care is the provision of ongoing treatment over a period of days, weeks or longer, using limited resources, perhaps absent most or all outside support, and in the absence of a working modern

medical care system. The role of the austere care nurse differs greatly from that of the modern "traditional" Nurse. The austere care nurse must be adept at improvisation, adapting to unusual circumstance and working conditions.

They may be home-trained or educated using a village healthcare worker model, or merely thrust into the role without any training beyond life experience. Even if educated in the traditional model of Nursing by way of a college, university or hospital-based program, one may find themself thrust by circumstance or design into a role for which all of your education and experience have failed to prepare you.

You may have to be your own lab technician, physical therapist, nutritionist and more. You may have the luxury of working with others or find yourself practicing completely independently of all outside assistance. Protocols and treatment regimens may have to be formulated on the fly depending on available resources and working conditions. Whatever your background, you may be expected to provide continuous, ongoing care lasting anywhere from days or weeks to months, or even, depending on the scenario you envision, years. In that respect, the care to be provided is no different in intent from the traditionally accepted nursing model of the day-to-day caregiver.

Successful practice of austere nursing may require you to assess, diagnose and treat people based upon your own assessment of the patient and situation absent the assistance of others educated beyond a basic nursing level. You may find yourself making decisions about what antibiotics to use, whether to close a wound or leave it open to heal by granulation, how to best address the nutritional requirements of your patient(s) and how to best ration scarce resources. The other chapters in this book contain invaluable information and guidance, provided by people who have trained and studied and practiced medicine in austere environments. In the end the ultimate responsibility may be yours alone to bear.

Remember this: by virtue of the circumstances under which you will be providing austere care your decisions must be based upon what is in your patient's best interests and not governed by medical-legal considerations. There will be no such thing as scheduled shifts limited to a few days a week, resupply a phone call or fax message away, and possibly no physician or other higher medical authority within traveling distance or in regular communication. Where regulation leaves off common sense and ethical considerations must take over. If your world was in proper working order there would be little call for austere practices to begin with.

B. Developing the Proper Mindset:

The first step in the process of adapting to the austere environment is developing the proper mindset. As stated above, the rules by which modern medical care is provided have little or no application here. In an austere environment, you will find that:

1. The system has broken down, either locally or across the board:

A. The breakdown is local with the rest of the world entirely or relatively unaffected. An example of this would be the Balkan conflicts of the early 1990's when physicians and nurses were charged with providing emergent and on-going care to victims of war, dealing with wounds, injuries and illness while meager supplies ran out and resupply, when it came at all, was sporadic at best and never close to enough or of the right items.

B. The breakdown is widely systemic on a national or even international scale. An example of this would be worldwide pandemic flu with millions of people ill at approximately the same time. Such an event would create a shortage of able and/or willing workers, creating problems not only within the modern healthcare system itself but also with manufacture and transportation. Recovery would be slow taking months if not years. Health care workers may suffer inordinate losses due to infections from those they are treating.

2. The system does not reach into the area of the world in which you find yourself practicing:

   The modern organized healthcare system with its hierarchy of responsibility doesn't apply, such as in backcountry areas of third world - and even some first world - nations (examples of the latter: the Alaskan bush country, the Hudson Bay region of Canada or the Australian Outback). In such places regulation and authoritative guidance is either lacking or entirely unavailable.

   If one finds themselves in neither of these situations there is one other general scenario that may require austere patient management to be implemented:

Occasionally circumstance prevents communication with the proper authority, either due to physical difficulty or because of severe time constraints. Examples would include:

- Lack of phone lines and/or radio-signal dead areas due to terrain or distance or atmospheric interference as during periods of high sunspot activity, or severe weather disturbance that brings down existing phone lines.

- A lack of all-weather roads, or roadways blocked by physical obstacles such as flood, mudslide, avalanche, deep snow or fallen trees. In such instances transfer or movement of the patient to appropriate care may be literally impossible. Local conditions may not allow air transport owing to weather, altitude, terrain or lack of suitable aircraft able to negotiate short landing strips.

- The time spent attempting to communicate with the proper authorities would endanger your patient, as when communication is available only on a scheduled basis or not in place at all and requires significant time to arrange. Not infrequently situations arise which need to be addressed post haste lest the patient's condition deteriorate while awaiting formal direction from higher authority.

If any single one or combination of the above sets of circumstances presents itself you now find yourself as the primary provider of healthcare services for your little band or community. We'll make it easy on you; you have occasional contact with a physician who is able to visit for a few hours every 2 or 3 weeks. In between visits you are basically on your own.

Now let's make it even easier. It so happens that one evening you are presented with an adult male in his mid-60's who managed to aggravate a pre-existing back problem while splitting wood for the stove. He is in significant pain, has a modest degree of numbness to his legs but good pulses to both feet, and is a Type II (non-insulin dependent) diabetic who managed to squirrel away a significant quantity of oral diabetic medications prior to world-changing events.

The circuit-riding doctor happens to be due the next day so you put the patient to bed after making him as comfortable as you can. He passes a very sleepless night as do you but there is hope with the awakening dawn.

The doctor makes his appearance as expected, examines your patient and determines that he has most likely managed to worsen that bulged disc in his lower back. Here is where the real world rears its ugly head. The nearest facility that can perform the type of surgery the doctor suspects is needed is over 250 miles (400 kilometers) away over rough roads and fuel is a precious commodity in any event. Local surgery of course is out of the question – even if he had the means available because your doctor's surgical skills during "Normal Times"extended no farther than setting simple fractures or performing appendectomies and hernia repairs

Your doctor friend reviews the man's medical history, makes some minor adjustments to his medications and prescribes a course of treatment pending his return in approximately 18 days. And with that he dons his hat and mounts his trusty scooter and rides off to the next villa on his route.

Now what? You have a patient who needs to remain bedfast for approximately 3 weeks, who has a history of diabetes, has pain issues and whose age makes him susceptible to developing complications such as pneumonia and skin breakdowns.

From this point on it is your mindset more than any trove of medications or medical reference books that will better determine your patient's outcome. You are going to have to feed, bath, sooth, medicate and treat your patient, with or without other assistance. His blood sugar levels will need to be monitored, his skin tended to by way of frequent repositioning and washing, a suitable diet provided that won't aggravate his diabetes, and make sure he doesn't develop any complicating factors such as the previously referenced pneumonia.

Sounds overwhelming already, doesn't it? It does not have to be. First, the points in your favor:

- The patient is not suffering from a life-threatening condition. It is painful and disabling but with time and care he can recover from it.

- You are fortunate enough to have the guidance of a physician. His instructions were precise and appropriate to the situation, mindful of the limitations you have as based upon resources and training.

- You have planned and laid in a stock of the tools you will need to provide the called for care. In this case the patient also has access to his own supply of specialized medication and you have instructions on how to manage the administration of these based upon regular readings of his blood sugar levels.

Here is where things can be tricky.

- Your patient is of a short and stocky build. He weighs in at 240 pounds (109 kilos). Because of his physical limitations, his weight will be a factor when planning his care.

- Due to the nature of his injury, the doctor has specified that he must lay more or less flat. He may be turned from side to side and may have his head slightly elevated but he is not allowed to sit upright lest he stress the already insulted lumbar disc.

- Because of his age, weight, and underlying diabetes he is at increased risk of developing pressure ulcers. Of concern are his feet – notably the heels – and his legs, which are likely to suffer somewhat from impaired circulation, not uncommon in diabetics.

Based upon the doctor's recommendations, you decide upon the type of bed surface (firm), have gathered propping pillows, arranged the room for maximum functionality and determined what of your limited stock of medications are best suited for relieving pain. Medication schedules are planned around mealtimes because of the underlying diabetes, and you'll perform finger sticks every 6 hours, recording the results of the chem-stick readings so you can adjust the medication as needed, occasionally cutting a dose in half as the decreased energy demands of the patient, due to his inactivity, affect the rate at which his body burns off calories.

Faced with this turn of events, you did not panic, you adjusted your thinking to fit the situation. You have arranged for a neighbor to help with bathing and other chores when brute force is called for, and another friend will help with meal preparation based upon her experiences with a diabetic parent in the past. Your patient is fortunately cooperative and resigned to a prolonged convalescence and accepts that he will be under your care for the foreseeable future.

Given time and proper care, he will likely recover. The pain will subside though it will probably remain in the background. He will regain mobility, though perhaps not to the same degree as before. Absent proper care, however, the injury could have become life threatening, confining the patient to bed or chair until, eventually, immobility alone causes his demise.

Continuing briefly with the scenario, the patient would also require a regimen of therapy once his enforced period of bed rest was completed. Exercises would be prescribed to strengthen the muscles of the back and abdomen and he would have been encouraged to bring his weight into closer ratio to his height. And he would be advised that chopping his own wood is something he should avoid in the future. His eventual recovery would not be 100% but he would return to a relatively normal level of function absent certain activities.

This is of course a very simplified scenario, and several pieces fell into place in the right manner at the right time. You had a doctor who could make a presumptive diagnosis absent imaging studies such as x-ray or CAT scans; the patient was farsighted enough to have a supply of specialized medication to keep his diabetes in check; you had the foresight to study basic austere nursing and to lay aside for a rainy day the tools necessary to provide said care.

Assuming one is a trained, licensed or otherwise authorized to practice as a Nurse or other appropriate health care provider, they will have to fall back upon the premise of what any reasonably competent person with equivalent skills, training, and experience would do given the same set of circumstances. Modern examples would be nurses and other caregivers responding to the World Trade Center crashes, the Asian tsunami, or any of the series of significant earthquakes that have become the norm in certain regions of the world. Emergent care was provided in all situations without benefit of prior authorization or proper tools, and in the latter two examples on-going care made do with what was available based upon the assessed needs of the patients, the given environments and available resources.

In the absence of formal training, a prudent person will identify their skills and the resources available and act within those boundaries. There is a wealth of information contained within the pages of this book that will set you well on your way to providing qualifiedly care under difficult circumstances. The

overriding premise here is "first, do no harm". But also important with that premise is knowing what may legitimately constitute harm to begin with. The planned benefits must outweigh the likely risks.

Just as use of this book does not constitute a license to practice medicine, study of this chapter does not grant one license to practice Nursing. Whatever the situation maybe you are morally if not legally bound to operate within the generally accepted standards of the ethical provision of care that aids in the recovery or comfort of your patient(s) without causing detriment by way of deliberate omission or a willful act of harm.

C. Hotel Care:

This is an odd section title but it describes an extremely important basic nursing function: the provision of the fundamentals of what are required for survival – air/food/warmth (shelter)/water/clothing – when you are looking after patients you must provide these essentials for them. Absent imminent threat these are the most basic of all nursing care functions. They are listed in the arguably approximate order of importance to life. Each of these areas applies not only to the patient but the caregiver as well. The patient cannot recover and the caregivers provide nursing care without these essentials.

Air

All people require air to breath. This does not mean housing patients outside in the open, exposed to all manner of weather and deprivation. It does mean that,when you establish your patient care and long-term holding area, you should pay attention to proper circulation. The air provided should be free of dust and noxious fumes and smoke. Filtration may be necessary to eliminate such threats.

Warmth/Environment

Next on the ladder of necessities is proper environment. Most often we equate this with adequate heat but sometimes adequate cooling is called for, as with desert and related hot climates. A properly hydrated person will stand a much better chance of surviving extremes of heat and cold with minimal ill effect, but these same extremes will cost a life much faster than they will ever starve to death, and quicker than they will succumb to thirst.

The adage about treating for shock by keeping a person warm has more than a ring of truth. Not only shock but also any number of ailments as well as injuries may cause a person to lose body heat. This is in addition to the issue of comfort. Besides covering them with warm blankets, think in terms of warming the bed itself. Try a hot water bottle, a heated brick or an old-fashioned bed warmer. All have been used for hundreds of years with good results. In the austere environment looking to the past for answers may provide answers to issues that otherwise seem insurmountable.

Likewise, cooling is sometimes essential to affect recovery. The body has its own cooling mechanisms but placing a strain on those same systems can require strength needed to heal wounds or illness. The human body functions most effectively in an environmental temperature range of 68 – 85 degrees F. (20 – 29 C.). Outside of those temperature ranges, the body diverts resources away from other functions – such as healing – in order to either heat or cool itself.

Elimination

Elimination is how our bodies expel or otherwise rid themselves of the waste products of metabolism, which is the use by the body's systems of food and water to provide fuel for the acts intrinsic to life. Urine, faeces, emesis and other waste products will have to be addressed and dealt with on a regular basis, normally several times daily in one manner or the other. Specific strategies for dealing with these products are listed later in this chapter.

Of the various means of elimination, urination is the most important. The inability to urinate (pass water) can lead to severe pain and an inability to function properly. Some people may normally pass several days without defecation but the person who can routinely pass 12 hours without urinating, and remain in a healthy condition is rare indeed.

Water

Water is critically important to life. A person may survive weeks with no food but as little as 72 hours with no water. Ensuring adequate hydration is a significant part of basic nursing care. Lack of proper hydration may lead to prolonged healing, decreased ability to fight infection, altered levels of awareness, improper waste elimination, and in severe cases, organ failure and eventual death.

Other than being taken by mouth, water can be introduced rectally (proctoclysis) as detailed elsewhere in this book, and of course by the familiar intravenous route if properly prepared IV fluids and someone trained to administer them are available.

The austere caregiver should be ready to provide clean water for drinking, bathing and a host of other day-to-day uses.

Food

Patients may require varying diets that may differ significantly from what they are used to. For something as simple as a tooth extraction a diet of soft breads, ground meats and mashed vegetables may all they can tolerate due to difficulties chewing. In addition to the information contained in another chapter of this book two other recommended books that include dietary information as it relates to medical care are War Surgery, Field Manual and Where There Is No Doctor. (See Reference chapter for further details).

Linen/Clothing

Clean linen and lots of it is one of the keys to providing good nursing care – sheets, blankets, washing cloths and towels. Until you have actually provided nursing care to an acutely ill person it is hard to believe how much linen you can go through in a day. Instead of thinking of one patient = one set of linens consisting of washcloth, towel, bottom sheet, top sheet, blanket, pillow and case think more akin to one patient = 3 washcloths, 3 towels, 2 each top and bottom sheets, 2 blankets, 2 pillows and cases, each and every day. And that will be only an average, not a likely end point; it makes no allowance for linens already waiting laundering.

Any patient who perspires, is nauseated and vomiting, bleeds, is incontinent of bowels and/or bladder or who has suppurating wounds in any form is going to require at least one complete linen change every day in addition to their regular daily change. Count on it and plan accordingly.

Likewise the patient will need to be clothed. Clothing provides warmth, protection and privacy in the sense that the human body is not immediately in view of others. Gowns, robes, even street clothes so long as they do not interfere with care.

Bringing It Together

Having established the basic areas of care that need to be addressed, we need to begin to bring it all together. Air is quite simple. Make sure there is proper ventilation for the area(s) where you intend to provide patient care. When infectious disease is involved, such as influenza, it means circulating the air away from other people and living areas. The simplest method would be to install a turbine ventilator to draw air into the area from outside the room(s) to the outer atmosphere, a simplified form of the negative air pressure systems hospitals use for isolation rooms.

Environment has been partially addressed in the preceding paragraph – proper ventilation is part of the environmental aspect of care. Ensuring adequate heat is another. Weather protection is a given, even if it is as simple as a large tent set up in the yard where an isolation patient can be housed away from others. There are a myriad of ways to provide safe heat to such a structure, much less an actual constructed building. If electricity is available, space heaters provide a safe tool for ensuring continuing, adjustable heat levels.

Elimination is addressed further below but in addition you need to plan for the proper disposal of potentially infectious body fluids and wastes. A latrine-like pit located well away from water sources, food plants, livestock, and living areas may be the most practical place to empty bedpans, urinals and emesis buckets.

Water requires no special preparation save that it be as clean and free of contaminants as practical. The same water you consume and wash with every day is the same water you will provide to your patients.

Food may require special preparation for texture, calorie and nutritional content and taste. Spicy foods can aggravate some conditions, and added salt likewise can be unhealthy for the patient for whom water retention (edema) is a problem.

Linens (bedding) will need to be washed as often as daily, assuming you have spare linens to provide while others are being cleaned. Because of the possible presence of blood, body fluids and feces they need to be handled with care, and provision made to sanitize them to the best of your ability. The simplest methods involved lots of very hot water (over 160 degrees F or 71 degrees C) and a disinfecting agent such as chlorine bleach.

Likewise, the clothing the patient wears will have to be cleaned regularly. For an acutely ill person in a hospital, where open-back gowns are the norm, it is not uncommon to change them 3-4 times a day because of excess perspiration (as with fever), emesis, incontinence, exudates, etc. Plan accordingly.

Hospital-type gowns can be made at home using the free downloadable pattern found here:

http://www.lazygirldesigns.com/hospitalgown.php

Do yourself a favor and make them up ahead of time. You'll have plenty of other things to do trying to address even an uncomplicated case of influenza.

D. Recovery Care

Once a traumatic or medical situation is addressed in the immediate term, we move on to the recovery, or sub-acute care phase. During this period, we will be concerned with addressing the continuing problems created by the illness or injury. If we will eventually have access to outside assistance, our job of providing for such cases is simply a matter of ensuring that recovery continues or that the patient's condition at least remains stable. If there is no outside assistance likely in the foreseeable future, our task is then to ensure the patient's eventual recovery to their former state of health.

For most people, this phase will be the most-time consuming. The patient may be suffering the after-effects of an acute illness, or require regular care for healing wounds and/or acute injury. In either situation their care is likely to require regular assessment of vital signs, elimination, pain and overall function.

During this phase of care you may reasonably be expected to administer medications on an ongoing basis, perhaps change dressings and apply various treatments intended to promote healing of wounds and/or injuries, provide for some or all of your patient's basic needs (reference Hotel Care above). You will need the use of various tools that make this phase of care practical, and to know the tricks that make such care practical as far as time and effort.

Care Planning

If your patient requires more than a few minutes of attention you need to take time to step back and assess the overall situation and devise a plan of care to guide your efforts. This is not as complicated as it sounds. In the hospital and long-term care environments nurses develop what are routinely called "care plans". These are detailed plans of care that are intended to be unique to each patient's needs, and tend to be as much centered on medical-legal considerations as actual necessary care issues. For our purposes, we need only to have a basic plan in place that is intended to ensure that the major aspects of required care are not overlooked. After that, common sense must take over.

Let's use the patient from the scenario a couple of pages back as our illustration model. A simplified care plan might take the following form if written out:

Vital Signs: check twice a day and record.

Nutrition: regular foods (no added salt) selected with attention to carbohydrate counts, 3 meals per day totaling approximately 1,800 calories, snacks in evening as appropriate to maintain blood sugar levels within desired range.

Positioning: rotate patient from side-to-side every 2 hours during waking hours, every 3-4 hours during the night. Use propping pillows to position from side to side to maintain straight body alignment.

Elimination: check every 2 hours. Needs assistance with urinal. Bedpan as needed.

Pain: assess pain level every 4 hours and give medication as needed.

Medication: administer scheduled medications at breakfast and suppertime after checking blood sugar levels.

For an uncomplicated case of flu with only one caregiver, a written care plan, as simple as it is, may not be needed. Simply establish a routine and follow it. If more than one patient is involved or there is more than one nursing care provider, having a simple written plan of action can eliminate potential mistakes and miscommunication such as administering medication twice or overlooking a significant change in the vital signs.

Basic Nursing/Patient Care Tools:

After establishing your plan of action, whether mental notes of a routine or an actual written schedule of actions to be divided amongst two or more caregivers, you need to make sure you have the tools needed to carry out your plan.

Nursing has its own tools of the trade: tools to assess vital signs, to address bodily functions, to make administration of medications possible and to make ongoing care practical. Aside from obviously disposable items such as bandages and dressings, durable goods are the most practical for situations where resupply intervals may be few and far between, or even non-existent. Glass and stainless steel are two of your best friends in such situations. If planning on providing ongoing patient cares look for equipment that can be found in durable forms.

You will need tools that measure blood pressure, pulse rate, weight, fluid volume and size (length, circumference and diameter) and temperature. Examples of such tools would be:

Blood pressure cuff: mercury column, aneroid (dial-type) gauge, or an electronic device such as a wrist or self-inflating arm cuff. Mercury column devices maintain calibration longer than other types and can be used to calibrate aneroid gauges, which are more portable. Electronic devices are great timesavers but are also prone to loss of calibration and growing inaccuracy as batteries are depleted.

Watch or clock: to obtain accurate pulse and breathing rates you need a digital timepiece that displays a second's count, or a sweep-hand that marks off seconds, as well as minutes and hours.

Graduated container and/or other fluid measuring devices: used to accurately measure urine output and also fluid intake. Common kitchen measuring devices with a capacity of 32 oz (or 1 liter) will work well. A see-through container with measurement markings will make the task much easier. This may see

a lot of use so durability is preferred. Pyrex is a common brand of durable, heat-resistant glass measuring vessels. The heat-resistant feature will allow proper disinfection.

Stethoscope: assessing lung and bowel sounds is a basic part of nursing care. You are checking for abnormal sounds in the lungs and the presence or absence of sounds in the abdominal area. A good quality single-head stethoscope with spare diaphragms and earpieces is considered the minimum must-have item for this. In the absence of one, however, a paper cone can be used to detect gross heart and lung sounds.

Scale: the type of scale isn't as important as the fact that whatever device is used measures the same way each time. The actual scale can be electronic, mechanical or improvised such as a balance beam and counterweights of known measurement. Even water displacement can be used so long as you have a means of measuring the volume accurately since water has a known weight per volume.

Fabric Tape Measure: Wounds may need to be measured to gauge healing progress. Edema (swelling) needs to be measured to determine if treatments are effective. Bandages may need to be measured for fit. A measuring device that will wrap around an extremity is more practical than a rigid ruler.

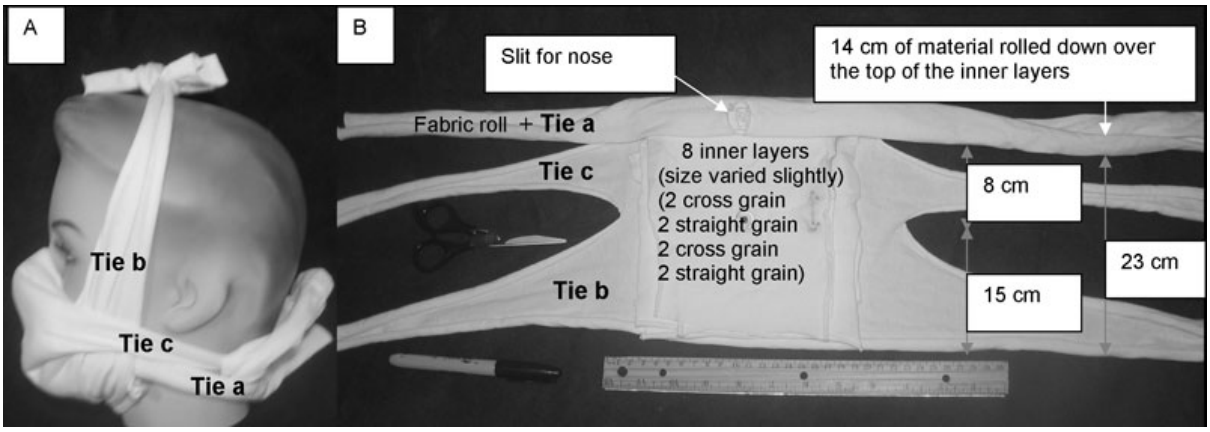
Flashlight: This serves a dual role as both as assessment tool for the eyes, ears, nose and mouth, and the means to check a patient at night without awakening them with overhead lighting. Room lighting is not always adequate to view whatever may need to be seen.

Bandage Scissors: designed to cut away bandages next to the body without poking holes in your patient. They combine safety with practicality.

Gloves: The most important tool you will ever use is the protective glove. Hospitals use disposable gloves by the thousands every day. Reusable gloves are of course available but they are time and energy intensive and are best reserved for utility tasks. However, given that latex gloves in particular – the most common type – are presently widely available and inexpensive there should be no reason not to have a few boxes of 50 pairs each (100 gloves) available. Plan though as sizes range from small to extra-large and the normal one-size-fits-all model is usually only a medium size. One caveat: latex deteriorates with time and high temps. Nitrile gloves cost a bit more but will withstand time and temps for well beyond a decade, eliminating waste due to deterioration. Vinyl gloves tend to fit loosely, have less stretch, and deteriorate almost as fast as latex when exposed to heat during storage.

Rubber kitchen gloves are the most commonly found type of barrier device in the average home. They are designed to be used time and again, and cleaned in between uses.

Masks: As odd as it may seem to think of you need to add protective facemasks to your list of basic, everyday tools. Sick people cough, sneeze, vomit or bleed, or a combination of any or all of these events. Any of these events can introduce infectious material into the air that you are breathing as you care for your patient(s). Plan accordingly and have masks – even simple homemade versions – available in quantity. Then there are the simple but easily overlooked tools that make ongoing care not only practical but less strenuous and safer for patient and caregiver alike.



a DIY face mask.

Permanent Marker: To write dates or times on dressings to know when they were last changed if there is more than one caregiver. It is also often used to mark disposable items that should not be shared between patients. Also, to mark skin (it wears off with repeated washing and normal skin replacement) when monitoring areas of local swelling (edema) or infection to determine whether it is gaining, retreating or remaining unchanged.

Transfer Belt: Known by various names such as walking belt, safety belt, gait belt, etc. The commercial version is a 3" wide sturdy fabric strap that is easily buckled around the patient so the caregiver can assist them with standing up, transferring or walking. It can also be fashioned from a pair of sturdy pants suspenders or an ordinary (wide) clothing belt. It provides a handle for the caregiver to grab onto by placing it around the middle (lower stomach area) of the patient and holding onto the rear of the belt.

Bedside Table: As simple as it seems having someplace to set things while providing care is extremely important. It isn't always practical to reach into your pocket for everything and setting tools, dressings, etc on the bed itself may be asking to have them contaminated or kicked off.

Clothing Protectors: Another simple yet important item that can be fashioned readily from any soft or fluid resistant material. Intended to catch spills while eating/feeding and protect the patient while washing hair or performing treatments. They may tie behind the neck or have a wrap-around collar that fastens with Velcro. By protecting from spills they also save a lot of time by guarding against the necessity of clothing and bed linen changes.

Gowns: Caring for people may routinely require exposing differing areas of their body for washing, administering medications, changing dressings and bandages or measuring vital signs. Having to undress a person is time-consuming and impractical as well as potentially painful. Modesty dictates that we be able to cover the patient when exposure is not otherwise needed. Open back gowns, while the bane of hospitalized patients worldwide, represent the most practical means of combining protection with accessibility when shirt-and-pant-style clothing is not practical or possible. Something as simple as a sheet cut out poncho-style will work nicely as well.

Nail Clippers: Finger and toenails continue to grow even when we are ill. Vanity issues aside, it may be necessary to trim nails to address issues of hygiene (germs love to hide under nails) and prevent inadvertent self-injury by a patient who may flail about with delirium due to pain or fever. Having properly designed and sized clippers for the fingers and toes makes this task much easier for all concerned.

Comb and/or Brush: Simple hair care not only makes the patient feel better about themselves but it can also reveal wounds hidden under hair, or remove insect eggs, as when the patient has body lice.

Straws/Drinking Tubes: As simple as it seems, these can be a lifesaver for both patient and caregiver alike. They make it possible for the patient who is unable to easily sit up to take fluids and nutrition while lying down. For the caregiver they can eliminate a lot of repositioning, saving time and stress on the patient.

Water Pitcher and Drinking Glass: Having water close to hand is very important for the bedfast patient. Hospitals still use them and you should consider having them available as well. If you anticipate several patients at once have individual pitchers and glasses or plastic beakers at hand.

Pill Crusher: Some patients may have difficulty swallowing pills whole, especially some of the larger ones like antibiotics. Administering them in a fruit puree, gelatin or ice cream in crushed form can make it much easier. There are commercial crushers available, and a mortar and pestle is a very effective means of accomplishing the same thing. Even a plastic bag in which to place the pills and a small hammer will do the trick.

Measuring Syringe: Administering liquid medications to children and some adults goes much easier when a needless syringe is inserted to the side of the mouth and the material squirted along the gum line. It is also a surer method of measuring precise doses.

Medication Cup: Plastic measuring cups of approximately 1 ounce/30 ml are readily available in quantity. These are used to measure liquid medications more accurately than the teaspoon method, and to carry pills when the patient has more than one or two to take at one time.

Wash Basin: Hospitals commonly use a rectangular basin with sides 6 inches (15 cm) high that tends to spill less-readily than a round shape. It also makes for an excellent emesis basin owing to its size and lack of sloping sides as opposed to the traditional kidney-shaped basin of old.

Providing On-Going Care:

Having identified our goals and the tools we will use, we can move on the issue of how we are to accomplish them. There are several areas that need to be addressed as part of the entire care “package” or plan.

Databases: Databases are simply recorded records of information such as heart rate and fluid elimination so that it can be studied later for comparison. A graph of temperature recordings can indicate a fever trend, for instance, or declining urine output can indicate decreasing kidney function or lack of adequate oral fluid intake.

Vital Signs:

Having a database of vital signs is the key to recognizing abnormal vital signs later. In an ideal situation, you would have a record that details normal laying, sitting and standing blood pressures for your patient, as well as a resting pulse and respirations, along with a temperature. Make sure to note whether the normal pulse is regular and strong in quality and rhythm, or irregular, weak or bounding (very strong). Use this as a baseline which to compare later recordings when called for. Illness and/or injury may cause these measurements to change drastically and having a baseline which to compare "normal"

measurements for your patient can eliminate a lot of guessing later. Assessing vital signs is covered in more detail later in the Q and A section. For the moment, we will concentrate on a few of the "whys."

Temperature

Temperatures can be used to monitor for the presence and progression of infections, adverse reactions to medications, and dehydration. Having a database of temperatures over time will allow you to gauge the effectiveness of antibiotics, for instance, or the onset of an infection. Similarly, a person who is acutely dehydrated will see an increase in their temperature. Be aware that it is quite normal for a healthy person's temperature to fluctuate by a degree or more between day- and night-time.

Pulse

Pulses may indicate a general state of health in the absence of illness or injury. A very rapid, thin pulse may indicate the presence of shock, whereas a relatively slow pulse might signal that the patient is relaxed and relatively pain free. Since pulse rates vary widely amongst people, the change in the frequency and quality is more important than the rate itself. For example, for a person whose normal pulse rate at rest is 68, an increase of 20 per minute may indicate the presence of unaddressed pain, developing infection, or other problems, even increased emotional stress.

Blood Pressure

Blood pressures are always obtained using a blood pressure cuff, either manually operated or electronic. Cuffs come in different sizes with a standard blood pressure cuff suitable for non-obese adolescents and adults. An upper arm larger than approximately 15 cm across will require a larger cuff for an accurate reading or a false high will result. Conversely an arm smaller than approximately 8 cm across will require a smaller diameter cuff or a false low reading will result.

Breathing

Normal breathing rates for an adult range between 14 and 20 per minute, or one breath every 3 – 4 seconds. During times of illness this may increase, with more than 30 breaths a minute, which is significant.

In addition to rate, the apparent effort used to breath can also be indicative of distress or absence of it. In a healthy person, breathing should come easily and gently. Respiratory infections can cause labored breathing, evidenced by increased effort and rate. By tracking breathing rates and quality along with other vital signs it is possible to determine whether treatments are having a positive effect.

Oxygen level

The advent of the digital age has made relatively inexpensive pulse oximeters, or devices that measure the percentage of oxygen in blood, a reality. If you have one available consider yourself fortunate.

Middle to late signs of oxygen starvation include cyanosis (bluish coloration) of the lips and nail beds, confusion, and decreased level of consciousness. Normally the patient will be obviously short of breath before they reach any of these stages.

Level of Consciousness

The Glasgow Coma Scale provides for a score in the range 3-15. A score of 15 means the patient is lucid and appropriate and otherwise fully conscious. Patients with a score of 3-6 are normally considered to be comatose. A score of 7-12 is regarded as a decreased level of consciousness, and a score of 13-14 indicates mild confusion. The total score is the sum of the individual score for each of the three categories. For adults, the scores are as follows:

Eye Opening Response	
Spontaneous--open without stimulus	4 points
Opens to verbal command, speech, or shout	3 points
Opens to pain only	2 points
None	1 point

Verbal Response	
Oriented	5 points
Confused but able to answer questions	4 points
Inappropriate responses, words discernible	3 points
Incomprehensible speech	2 points
None	1 point

Motor Response	
Obeys commands	6 points
Deliberate movement to painful stimulus	5 points
Withdraws from pain	4 points
Abnormal (spastic) flexion, decorticate posture	3 points
Extensor (rigid) response, decerebrate posture	2 points
None	1 point

For children age 5 and under the verbal scoring is modified as follows:

SCORE 2 to 5 YRS	**0 TO 23 Mos.**	**Score**
Appropriate words or sentences	Smiles or coos appropriately	5
Inappropriate words	Cries but is consolable	4
Persists in cries and/or screams	Inappropriate crying &/or screaming	3
Grunts	Grunts, agitated or restless	2
No response	No response	1

Unlike the other measurements, the coma scale is not used routinely but rather when alteration in the normal level of consciousness is an actual or potential complaint. In the austere care environment, it is a measuring tool only.

Other Data to Collect and Record:

Bowel Movements

As we age our bowel movements tend to become less frequent. Normal for an infant is several loose stools each day. Adolescents and adults may have one per day. Older adults may not have a proper bowel movement for several days without regular use of fiber in their diet and/or laxatives. As a rule a person should have one medium to large bowel movement at least every 3 days. Bear in mind that this is not absolute. Inquiring of the patient what their normal pattern is can be very helpful, especially if they relate that they regularly have only 2 bowel movements in a normal week and are otherwise healthy.

The quality of the bowel movement may also be very important. Diarrhea, or loose, watery stools of a frequent occurrence, is not often desirable. A lack of formed regular stools is an indication of overall health. By noting the quality and frequency the nurse can determine when and if intervention is necessary. Whereas one or even two loose stools is not reason to start administering anti-diarrheal agents, a continuing pattern of loose stools that lasts for a day or longer indicates a threat to health that needs to be addressed.

Urination

It is not necessary to record urine outputs for everyone but for some cases – especially burns - measuring output against fluids taken in (Intake and Output) is necessary to determine whether fluid balance is being maintained. A healthy adult can be expected to void (urinate) 800 – 2,000 ml per day. The effects of disease, loss of fluids through other sources such as perspiration, vomiting, bowel movements, etc. may affect this somewhat but as a rule plan on a measured output of about 1+ over a 24-hour period. Anything less than half this amount may be indicative of kidney malfunction and is cause for serious concern.

Intake

Without recording the amount of fluids taken in orally or by other means, there is no way to ascertain whether the urination output is in line with the intake. Likewise, when you wish to rid the patient of excess fluids, as with edema (swelling) or "bloat", and have the appropriate medications or alternative remedies available to encourage this, you will need a record of how much they are taking in versus how much they are putting out.

For certain types of patients, such as burn cases or those with heart failure, matching Intake and Output (I & O) against daily weights can be critical to determine if an output deficit is the result of retained fluids when it is not otherwise clear as evidenced by swelling.

Weight

Weight by itself may mean little other than as a general indication of nutritional status but changes in weight can be significant in terms of indicating changes in the patient's condition. For instance, fluid retention or loss can vary a person's weight by several pounds (2 – 3 kilograms) per day. Sudden fluid gain can precipitate heart failure, and may indicate failing kidney function if present along with decreasing urine output. Sudden weight loss normally indicates a loss of fluids from the body, a very important consideration with large-scale burns where we want to achieve balance in the body's fluid load.

Emesis

Emesis, or vomiting, is considered a form of output that needs to be gauged as to frequency and volume. Emesis depletes the body of fluids. The more that the patient loses in this manner the more you need to factor in for replacement.

Braden Scale

The Braden scale is a tool used by medical personnel to determine the relative risk for any given patient of developing decubiti ulcers, otherwise commonly known as bedsores. It is comprised of 6 subscales with scores of 1-4 each for a total overall score of 6 (extremely high risk) to 23 (very low risk).

In everyday Nursing care the Braden Score is often seen as a time-consuming nuisance, which it can be with the standard emphasis on rescoring the patient with every change of shift (2-3 times/day). Under austere circumstances it may be regarded as a tool for specific situations rather than a twice or three times daily event. Patients who can reposition themselves in bed at regular intervals, who are younger than approximately 60 years of age and otherwise in good health, and especially those who are ambulatory, are at minimal risk.

BRADEN SCALE

For Predicting Pressure Sore Risk in Home Care

Patient's Name: _____ Evaluator's Name: _____ Date of Assessment: _____

SENSORY PERCEPTION ability to respond meaningfully to pressure-related discomfort	**1. Completely Limited** Unresponsive (does not moan, flinch, or grasp) to painful stimuli, due to diminished level of consciousness or sedation. OR Limited ability to feel pain over most of body.	**2. Very Limited** Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness. OR Has a sensory impairment which limits the ability to feel pain or discomfort over 1/2 of body.	**3. Slightly Limited** Responds to verbal commands, but cannot always communicate discomfort or the need to be turned. OR Has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities.	**4. No Impairment** Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.				
MOISTURE degree to which skin is exposed to moisture	**1. Constantly Moist** Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.	**2. Often Moist** Skin is often, but not always moist. Linen must be changed as often as 3 times in 24 hours.	**3. Occasionally Moist** Skin is occasionally moist, requiring an extra linen change approximately once a day.	**4. Rarely Moist** Skin is usually dry; Linen only requires changing at routine intervals.				
ACTIVITY degree of physical activity	**1. Bedfast** Confined to bed.	**2. Chairfast** Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	**3. Walks Occasionally** Walks occasionally during day, but for very short distances, with or without assistance. Spends majority of day in bed or chair.	**4. Walks Frequently** Walks outside bedroom twice a day and inside room at least once every two hours during waking hours.				
MOBILITY ability to change and control body position	**1. Completely Immobile** Does not make even slight changes in body or extremity position without assistance.	**2. Very Limited** Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	**3. Slightly Limited** Makes frequent though slight changes in body or extremity position independently.	**4. No Limitation** Makes major and frequent changes in position without assistance.				
NUTRITION usual food intake pattern	**1. Very Poor** Never eats a complete meal. Rarely eats more than 1/3 of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement. OR Is NPO and/or maintained on clear liquids or IV's for more than 5 days.	**2. Probably Inadequate** Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only 3 servings of meat or dairy products per day. Occasionally will take a dietary supplement. OR Receives less than optimum amount of liquid diet or tube feeding.	**3. Adequate** Eats over half of most meals. Eats a total of 4 servings of protein (meat, dairy products per day. Occasionally will refuse a meal, but will usually take a supplement when offered. OR Is on a tube feeding or TPN regimen which probably meets most of nutritional needs.	**4. Excellent** Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.				
FRICTION & SHEAR	**1. Problem** Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractures or agitation leads to almost constant friction.	**2. Potential Problem** Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	**3. No Apparent Problem** Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair.					
				Total Score				

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Physical Aspects of Patient Care:

Thus, far we have discussed why we might need to consider long term care in our austere medical plans and the mindset that will be required to address such issues. We've prioritized the necessities of air, water, etc. that will factor into our plans, and the normal and extraordinary aspects of elimination and waste. Now to address the issues that are the very meat of this chapter: what care to provide.

Bed Mobility and Positioning

The ability to change positions in bed is often taken for granted by those not affected by illness or mobility problems. Pressure sores, which will be addressed later in this section, are one potential problem of immobility. Increased tendency towards pneumonia is another.

Lifting Frames

One device useful for caregiver and patient alike is the overhead lifting frame, or trapeze bar. This is an overhead frame that is firmly secured to the bed, wall or floor. The traditional model uses a triangular handle secured to the bar or frame positioned overhead by means of sturdy strap, rope or chain. The bar or strap is used by the patient who has the upper body strength to lift themselves off the bed, allowing for self or assisted repositioning, or for the caregiver to change the bed linens without the patient exiting the bed. It saves both time and physical stress and offers the bedfast patient a sense of self-reliance.

Side Rails

As simple as the concept sounds, having removable railings alongside the bed may be an important factor for both patient and caregiver. Besides preventing a weak or disoriented person from inadvertently rolling out of bed, they can be used by the patient for repositioning by providing them with a handle to grab onto to pull or roll themselves. Modern hospital beds have fold-down rails but removable railings can be fashioned by fitting them with "legs" that attach to the bedside using screw clamps or other type of easily removable fastener. This will allow for a measure of safety while also allowing full access for bedding changes and transfers. In most cases half rails that protect the upper half of the bed are sufficient.

Positioning

Positioning can be defined as the art of arranging the patient properly to encourage maximum retention of function, comfort and accessibility. As simple as it seems, improper positioning can and does lead to breakdowns in skin integrity, loss of function of limbs, and prolonged recovery times.

Elevation

Elevating the head of the bed aids in breathing for some people, especially in instances of pneumonia, asthma, and emphysema, and can assist with keeping the airway clear. It is also more conducive to eating and taking liquids. Simple techniques for achieving this in a bed not otherwise designed for the head to be elevated are to use blocks under the legs at the head end, or to place blocks, pillows or other items under the upper portion of the mattress.

Positioning Pillows

To reduce any tendency towards pressure sores and to increase patient comfort it is common practice to alternate the way patients lay by positioning them first on their left side, then their back, and finally on the right side before starting over, with changes every 2-3 hours.

Pillows are used to prop the person who is otherwise unable to lay on one side unassisted. They are also used to elevate limbs to reduce edema (swelling) and to provide comfort. Some people may also breathe better with two or even three pillows under their upper back and head.

Other Positioning Aids

In addition to pillows, blanket rolls and folded towels may be used. These are used by placing them between the knees so that air may circulate and to keep the weight on one leg off the other when the patient is unable to reposition on their own. Unrelieved pressure puts the patient at risk of skin breakdown and locally impaired circulation. Other areas where thinner cushions may be used are under the shoulders, the neck, behind the knees, and under the small of the back.

Personal Hygiene

Personal hygiene is a significant area of concern. The patient may be unable to reach their back, for instance, due to arthritis or injury to the arms, back or shoulders. They may be unable to bend at the waist and thus unable to cleanse themselves below that point.

Plan to provide for regular bed baths, to trim fingernails, wash hair and provide for basic oral hygiene by brushing teeth and rinsing the mouth. Wiping the person daily with a damp cloth helps control the odor of perspiration, with a complete bed bath every 2-3 days recommended.

Bodily Functions

You will need to provide for your patients' elimination requirements: urine, feces and perspiration (sweat). Don't forget also that emesis (vomiting) is also a potential problem that will need to be addressed. This is dealt with more in depth in the following sections below.

Pain Assessment

Pain is a particularly subjective experience, with no two-people experiencing it quite the same way. Identical injuries may elicit differing responses in different people. One person may find the same pain tolerable that another finds excruciating. There is no definitive measure of pain but there are a couple of useful tools that offer clues as to how much pain the person is experiencing.

Pain is often measured using a 0 – 10 scale, with 0 (zero) being the complete absence of pain, and 10 (ten) being the worst pain the person has ever experienced or the worst pain they can imagine, often referred to as excruciating pain.

Another scale often used is the 5-point scale, which is graded as follows:

1 – No pain

2 – Mild pain

3 – Moderate pain

4 - Severe pain

5 – Overwhelming pain (the worst the patient can imagine)

In general, any perceived pain that the patient describes as 2 (two) or above is worthy of being addressed, beginning with simple pain measures or remedies and progressing as needed. Ideally, we would relieve the pain entirely but the very nature of medicine in general - austere or not - dictates that we may have to settle for reducing the pain to a level that is either tolerable for the patient or at least allows them to function.

Nutrition

As mentioned previously two books recommended in the References section offer information about nutritional support in the austere setting. There is a wealth of information available both on-line and in print regarding nutrition but a few general suggestions are offered here:

Trauma victims in general - and burn victims specifically - require significantly more protein on a daily basis than an otherwise healthy person. In the austere environment plant protein alone is likely to be insufficient to meet these needs. Animal protein (meat) will provide a better balance of the complex proteins needed to rebuild damaged muscle tissues.

Orthopedic patients may recover faster with the addition of calcium supplements to their diet. In addition to milk and other dairy foods, OTC supplements such as calcium-based antacid tablets may be of benefit to rebuilding damaged bones.

Following invasive procedures that involve the abdomen, a clear liquid diet is preferred until the patient regains normal bowel function. Clear liquids consist of water, broth, gelatins (flavored or not) and tea (but not coffee). Frozen flavored ices (Popsicles) also fall under this category even though they are not technically liquid when frozen. The general rule of thumb in determining what constitutes a clear liquid is the ability to see the bottom of the cup or glass through the contents when they are at room temperature.

Breathing Care

Patients with chest infections or chest injuries (who as a result may be more prone to chest infections as a secondary problem) may need some help with their breathing. The mainstay of treatment of difficulty with breathing is to increase the amount of oxygen that is available to the patient. Medical oxygen itself is unlikely to be available to you so you need to consider alternatives to assist with optimizing breathing.

Positioning is very important. Lying flat is not good for breathing when it is otherwise compromised. Semi-reclining or sitting upright is probably the best position.

Fully inflating the lungs with each breath also improves breathing, opening the smaller airways and helping the body clear out mucus. This can be achieved by alternately asking the patient to try and blow

up a balloon or a similar activity and sucking in through a straw for several minutes each several times a day

Percussion (firm patting with cupped hands) on both the chest and back with the patient lying flat with the head of the bed tilted down for 5-10 minutes several times per day may also help clear mucus from the chest.

Simple devices that may assist with breathing care include steam and cool mist vaporizers. Steam vaporizers are easy to improvise with something as simple as a pan of clean water set to heat near the patient and some sort of containment – such as a plastic sheet, or even a cloth sheet if nothing else is available - used to hold the mist in proximity to the patient. Simple medications such as menthol or herbal remedies can be placed in a pan over the heating water. Using salt water in a concentration of approximately 1% in conjunction with the cool mist vaporizer will also help some in clearing mucous.

A simple alternative to lack of electricity to power a nebulizer machine is to use a common bicycle pump to provide an intermittent but effective source of pressurized air that will vaporize whatever suitable medication is used in the chamber. This method of powering a nebulizer is, however, time consuming and labor intensive.

Emotional Care

Emotional care is called for any time a person is ill or injured. It may be as simple as a mother's soothing words to a child with a stomachache, or as involved as deliberate emotional support for the person who has suffered a significant injury and is experiencing a depression as a result of their misfortune.

Be aware that people experiencing ongoing pain and/or disability may become short-tempered and irritable. This is usually an unconscious response on their part that improves with recovery or increased comfort. The caregiver needs to be understanding of this and separate a temporary condition from true personality traits.

Simple comfort measures, observance of modesty issues, and sometimes just providing an ear for the patient to express their concerns or frustrations to can go a long ways towards addressing these issues. The person who is the subject of your care is likely to feel vulnerable if not outright helpless. Anything that can be reasonably done to reduce these feelings will make the situation more tolerable for both the nursing care provider(s) and the patient alike.

Physical Activity

Physical activity is a key issue for everyone. As noted previously immobile limbs tend to contract due to lack of muscle use. Simple range of motion exercises can aid greatly in preventing this as well as other complications. The key is gentle exercise. Limbs should be flexed and extended within the normal limits of the joints as practical. Fingers should be flexed as well as the wrists, elbows and shoulders. For the lower extremities: the hips, knees, ankles, and the toes if practical.

The person whose care requires casting for a period of time will find that, upon removal of the cast, the immobilized limb will be very weak. Begin with simple stretching and bending several times a day as pain

levels allow. Don't be discouraged when progress seems to be slow. Even a muscular individual will find full recovery will easily take weeks before they have their full strength and range of motion restored.

E. Basic Medications, Treatments and Pharmaceutical Aids

This portion of the chapter will serve as a modest guide to the medications, treatments and pharmaceutical aids important to proper nursing care. None of the recommended medications, etc are intended to treat or cure disease processes. Rather they are selected because they address symptoms and make the patient more comfortable. Selection of antibiotics and other medications requires diagnosing in order to determine which should be used. As our purpose here is not to diagnose but rather to provide a healing environment, no recommendations are made that rely upon diagnostic skills. Instead observational skills are all that are called for. These recommendations are for medications, treatments and aids that may serve to make the patient more comfortable while they are under your care.

Please note that not everything mentioned here is widely available to everyone. In some countries – notably the US and other western nations – even seemingly simple, basic medications are prescription-only items. But for readers who reside in Asian or Middle Eastern countries, Mexico or Central America many medications ranging from the very simple to the semi-complex are sold over-the-counter (OTC) without prescription.

Nausea/Vomiting

Many illnesses may have this as a common symptom. Common flu, various gut bugs and even prolonged stress can cause the patient to feel sick to their stomach and even actively vomit. Bad water, spoiled food, concussion, intestinal blockage (see "Constipation") and other causes also exact their toll. A patient whose nausea is relieved will be better able to rest, to take in nutrition, and is less likely to add dehydration to their other problem(s).

Reglan (Metoclopramide) – Frequently prescribed for prevention of nausea as well as used to stop active nausea and vomiting. Available in oral, injectable and IV forms. Readily available in oral form as an OTC in some countries as mentioned above. Sometimes regarded as the drug of choice for nausea secondary to migraine headache.

Benadryl (Diphenhydramine) – Common and widely available OTC antihistamine that has fair potential for nausea control, especially when used in conjunction with other medications such as Reglan. Widely available in liquid, pill and capsule forms.

Dramamine (Meclizine) – Commonly sold as a motion sickness preventative is may also be useful for nausea/vomiting due to illness. Should not be used with alcohol or in children under age 12. Available OTC at half the usual prescription dose.

Peppermint – often given as a tea, widely available in mint lozenges and candies. Not as strong as medications listed above but offers some relief. Very old and effective home remedy.

Ginger – Another old remedy that is still used in some hospitals as well as the home in the form of a soft drink called ginger ale. Ginger has a reputation for being soothing to an upset stomach.

Emetrol – An OTC product available in the US it's active ingredients consist of two types of sugars (glucose and fructose) and phosphoric acid. The usual dose for children over 12 and adults is 1–2 tablespoons (15 – 30 ml) every 15 minutes, up to a total of 5 doses.

Pepto-Bismol – Another OTC product in the US and Canada most will be familiar with. The active ingredient is bismuth subsalicylate. The product should be avoided by anyone with allergy to aspirin. Available in liquid and tablet forms.

Soda Crackers – Also called cookies in some cultures, they are a crisp, otherwise relatively bland food that is often used to settle a queasy stomach when other interventions are absent. Sometimes an empty stomach is itself cause for a patient feeling nauseous.

Relaxation – as condescending as it may sound the promotion of relaxation may serve to decrease nausea and vomiting.

Distraction – another non-pharmaceutical technique that works better in conjunction with medication or herbal remedies.

Pairing – Simply stated this is giving medications together when it is known one may cause nausea/vomiting, such as with aspirin or ibuprofen for some people. By giving Reglan or Benadryl at the same time as a stomach-upsetting pain reliever or antibiotic tablet or capsule the adverse effects may be decreased or even eliminated. It also may take the form of a non-pharmaceutical action that takes place at the same time as the administration of the offending medication.

Diarrhoea

Diarrhea may range from the merely inconvenient to truly life-threatening. Frequent loose, watery stools characterize it, generally more than 3 per day. After more than 2 days the patient may be in danger of acute dehydration, or lack of water within the body, if they are unable to replace lost fluids by way of oral intake. This can cause additional problems that need to be addressed in addition to the original ailment.

Controlling diarrhea can be both difficult and controversial. When a toxic agent such as bad food, a bacterium or virus causes it, stopping it may be counterproductive by inhibiting the expulsion from the body of the offending substance. You need to determine when diarrhea represents a legitimate threat to the patient and then how best to intervene accordingly, and when to let it run its course.

Most medications and treatments available for diarrhea do not cure the problem but only address it symptomatically. That is, they control the symptom (diarrhea) but do not treat the cause. Fortunately in

most instances time alone will provide the cure. Following are commonly available treatments that may be available.

Imodium (Loperamide) – Available in brand name and generic versions as a liquid, capsule or pill. Commonly available throughout the world as an OTC medication it works by decreasing the motility (rhythmic movement) of the bowel (intestine), allowing more water to be absorbed rather than expelled rectally. Best avoided in cases where there is visible blood in the stool or fever is present.

Rice Water - A simple home remedy based on ingredients that should be widely available over much of the world. Even if rice is not normally a part of your diet it is worth adding to your medical food stores for this and other uses.

3 cups water
1 cup regular white rice

Bring water to boil.
Add rice and simmer for 15 minutes.
Pour off the water into an appropriate container.

Special Note: if the patient is diabetic the rice water will count as a carbohydrate source, though not a particularly significant one.

Pepto-Bismol – Another use for this product besides controlling nausea and emesis. Effective for simple forms of diarrhea though seldom effective with just one dose. The active ingredient is bismuth subsalicylate. The dose should be limited to 30 ml every 30 minutes to hour, to a maximum of 8 doses in 24 hours.

Bactrim DS – a common antibiotic that may be useful if the underlying cause is bacterial. No longer considered to be a first choice due to resistance by the organisms that are the common cause of diarrhea – especially so-called "Traveler's Diarrhea" – it nevertheless may be a case of using what you have. Antibiotics are very seldom the first medication of choice for diarrhea and many can cause diarrhea in their own right by killing off the beneficial bugs normally found in the bowel. As such, they are only mentioned here in passing as they are not likely to be of benefit except in very specific, and at that - uncommon - circumstance.

BRAT Diet – So called because of the first letters of the foods involved when written in English (Bananas, Rice, Apples and Toast). The foods are generally considered to be easy to digest, low in fiber and bland, thus not as likely to add to an already upset stomach. Other foods that could be used or are often recommended in conjunction include yogurt, green tea, crackers and cooked cereals such as Cream of Wheat or Farina.

Insomnia

Insomnia (the inability to fall to and remain sleeping) is a very common complaint for any hospitalized patient. There is no reason to believe that it will be any different for the austere caregiver and their patients. Lack of sleep can cause delayed healing and recovery as well as make the patient less amenable to therapy

There are several prescription sleep aids on the market that can help induce slumber. If they happen to be available they should be used with caution as they will not likely be easily replaced when the on-hand supply is exhausted. Very briefly those commonly available in the US include Ambien (zolpidem), Restoril (temazepam), Rozarem (ramelteon), Lunesta (eszopiclone) and others such as Desyrel (trazadone). None of these should be used in conjunction with alcohol. All have the potential to cause a phenomenon known as rebound insomnia, wherein the body becomes accustomed to them and the original problem – sleeplessness - returns worse than before. Psychological as well as physical dependence is a potential problem with any of them. Reduced alertness the next day is also a common side effect.

Non-prescription sleep aids are very common, often consisting of antihistamines such as diphenhydramine (our old friend Benadryl) or dimenhydrinate, which is a salt of diphenhydramine and considered weaker in terms of its sedating potential. Depending on the brand and formulation they come in the form of pills, capsules, syrups, chewable tablets or elixirs.

Benadryl (diphenhydramine) – Generally considered to be non-habit forming. Usual dosing starts with 25 mg taken orally. Sometimes 50 mg is used but it is generally considered best to start with and use the lowest effective dose. Syrup or elixir will allow intermediate dosing, i.e. 37.5 mg as opposed to 25 or 50 mg, by merely adjusting the measure of fluid medication administered.

Herbal Sleep Aids – Valerian Root, Hops, Lavender and Passion Flower are common alternative sleep remedies.

Melatonin – Technically a hypnotic agent (as is Benadryl), melatonin is used to address problems with onset of sleep. It does not, however, address the problem of staying asleep.

Chamomile Tea – A mild sleep aid, it nevertheless works well for some people. A popular commercial brand has been sold in the US for years under the name of Sleepy Time. One or two cups taken shortly before laying down to rest may be of benefit.

Music – Soft music has long been known to have a calming effect. Some doctors use it with their clinical practices to induce a state of relaxation during procedures, most notably dentists.

Other Measures – Blocks to sleep include caffeine, nicotine and alcohol. Avoid consuming coffee, tea or caffeinated soft drinks at least 3 hours before attempting sleep. Likewise avoid smoking or otherwise using tobacco. Even alcohol, which though technically a sedative, can have an opposite effect on some people. As a general rule none of these are conducive to proper healing in any case.

Pain Management

Pain is an everyday problem associated with most injuries and many illnesses and disease processes as well. Even with the tools that we have available in a fully functioning healthcare system, it can be very difficult to manage for some people.

With that in mind, we need to be prepared to address pain issues for our patients, ranging as they may from the modest to the severe. Pain itself does not physically damage a person in any manner we can

measure, but it can cause depression, loss of sleep, prevents the body from functioning properly and limits healing because of the other limitations it places upon the body.

Strong pain relievers are not likely to be available to the austere care provider save those residing in a very few countries that do not have prescription requirements. Such medications tend to fall under the classification of narcotics – drugs with strong addiction potential and the ability to alter the senses. They are also inclined to be very dangerous drugs when used by the wrong hands; as such they are not something we would wish to turn to right away even if they were available.

The most common category of pain relievers that is likely to be available is the NSAID (Non-Steroidal Anti-Inflammatory Drug). NSAIDs have gastric distress as a common side effect and induced bleeding ulcer formation is not unknown with regular use. All offer analgesic (pain-relieving), anti-inflammatory and anti-pyretic (fever reducing) properties. Unlike opiates, larger doses do not produce greater effect as far as pain relief. The maximum recommended dose should never be exceeded for that reason. Following are several common medications that fall into this category.

Ibuprofen: Widely available in both generic and brand name forms Ibuprofen likely represents the most potent pain reliever many non-physicians will have available to them. Fortunately, it works, if not always as well as desired, for many medical problems short of the catastrophic. It is commonly dosed in 200 mg increments, up to a total of 800 mg per dose given either 3 or 4 times a day. In any case one should not exceed 3.2 grams (3,200 mgs) per day.

Toradol (Ketorolac): a prescription-only item in the US it is found in both injectable and oral forms in some countries where it is sold OTC. Assuming the proper form is available it may be administered via the IV, IM or oral routes. IV or IM use is usually limited to a maximum of 2 days (6 doses), followed by the oral form for several more days. Dosing is normally 30 or 60 mg 3 times a day. In people over 60 years of age the dosage should be limited to 30 mg per administration to avoid aging-related complications.

Aleve (Naproxen Sodium): Works longer than Ibuprofen, with reported relief lasting approximately 7-12 hours per dose. It is popular for arthritic-type pain and works well for some people, whereas for others it seems to be no more effective than Ibuprofen. Close observation for signs of bleeding ulcers is required, as it is for any NSAID.

Aspirin: The original NSAID, it is also the oldest of the non-narcotic pain relievers aside from herbal remedies. It is also the only one that becomes toxic with age, causing increased risk of stomach bleeding and gastric upset. The enteric-coated version probably offers a longer shelf life as exposure of aspirin to oxygen and humidity tends to degrade it very rapidly. Aspiring should NOT be used for children younger than the late teen years owing to an established connection between its use in the presence of viral illnesses and the development of a serious neurological condition known as Reye 's Syndrome.

Tylenol (Acetaminophen, Paracetamol): A very common medication available worldwide under various names. Effective for mild to moderate pain. Caution should be used due to the fact that it is a co-ingredient in many medications used to address pain, fever and cold symptoms. No more than 4,000 mgs (4 grams) should be administered within 24 hours from all sources combined. Be sure and check the labels of any OTC remedies being used to see if they contain Acetaminophen in order that total dosing may be determined. Tylenol should never be taken in conjunction with alcohol due to increased liver toxicity.

Non-Pharmaceutical Interventions: When we think of pain control it is often in terms of medications. In truth, significant pain relief can be obtained by use of techniques and interventions that do not rely on drugs. Proper use of temperature, movement, position and manual stimulation have all proven effective.

Cold: Cold application, especially in the form of ice, can control muscle spasm. Application is limited to 15-20 minutes several times daily to prevent cold injury to skin and underlying structures.

Heat: Available in both wet and dry forms, heat application can be effective in relieving the pain associated with muscle strain. Wet heat can be improvised by soaking thick cloths in hot water, wringing them out so that they are wet but not dripping, and then placing them on the area of the body targeted for pain relief. The ubiquitous hot water bottle so common in homes in decades past still serves a purpose. Heat therapy, like cold, is also limited to durations of 15-30 minutes several times daily.

Salves: Commonly available are medicated rubs, or salves, that use simple ingredients to address localized pain such as muscle strain. Menthol, cayenne pepper (capsaisin), camphor, eucalyptus and aspirin are common ingredients.

Appetite

There is little that can be done to stimulate appetite in a person who has none, but we are not without remedies. Megestrol is one drug commonly used to stimulate appetite but it is unlikely to be available to you.

Arranging food on the plate in a tempting pattern, altering the color and texture, and offering foods the patient finds particularly pleasing constitute the simplest methods of increasing appetite. Don't forget that exposure to food odors can work both ways, either increasing appetite or causing the patient to turn away if the thought of food is unsettling.

Another method is to first offer food or drink that sharpens the appetite such as improvised hors d'oerves or bits of cheese. There is also a tea reputed to increase appetite, the recipe for which follows:

Appetite Stimulant Tea

Ingredients:

1 teaspoon, fresh, grated or dried ginger root
2 cups water
¼ teaspoon each peppermint leaf, anise seed and cinnamon
1 teaspoon honey (optional)

Directions:

Simmer ginger in water a few minutes, and then remove it from heat.
Add other ingredients.

Cover and steep for about 20 minutes.
Strain.
Drink 1 or 2 cups as needed.

Itching

Known technically as pruritis, itching may be caused by the healing process – especially when it involves the growth of new skin – or by lack of circulating air and moisture to the skin, as when it is covered by bandages or casts.

While scratching an itch can aid in relieving it there is also the possibility of opening fresh wounds if fragile skin is raked by fingernails or improvised scratching devices. Less invasive methods of relief are then preferred. In some cases, as with the previously mentioned casted or bandaged limbs, reaching the area of discomfort may not be possible.

Drugs that reduce itching are properly referred to as anti-pruritics. Following are a few examples that may be available to you.

Antihistamines: Benadryl is a very commonly found example. It is widely available in the form of creams or salves for direct application, as well as tablets and capsules.

Herbals: Menthol is one example, camphor is another. These are used topically (on the surface of the skin). A related though not exactly herbal remedy is olive oil. Beware though, as it can cause fungal skin infections to worsen, as they tend to flourish in the presence of vegetable oils.

Foreign Remedies: A common OTC remedy found in Mexico and other countries uses Nystatin – a topical antifungal, and Triamcinolone – a corticosteroid – to treat itching caused by fungal infections such as yeast. One generic brand is called Bidrozil. It comes in cream form and is applied 3-4 times daily to the affected area.

Cold Cream: A potential remedy for dry and/or flaking skin that is accompanied by itching, as with sunburn. Noxzema is a familiar brand sold in the US. The active ingredients are camphor, menthol and eucalyptus.

Oatmeal Bath: Oatmeal has a long history of use as an anti-pruritic. Use approximately 1-2 cups of finely ground oat flakes in the bath, achieving a milky coloration that feels slick to the skin.

Non-drug/herbal treatments may also give some relief from itching, such as ice, cold water, or a hot shower directed on the offending area.

Constipation

Alternatingly boring and the subject of jokes as it is, constipation can be a serious issue for the bedfast patient. There are probably as many remedies for constipation as there are causes, ranging from prescription items to the everyday kitchen recipe. Occasional simple constipation strikes everyone at some time. Being confined to bed by illness or injury can cause a disruption in the normal pattern of bowel movements. Fortunately, most cases are easily handled by simple measures. A few suggestions follow for dealing with this problem.

Fiber: Increasing dietary fiber is the simplest remedy for chronic constipation. There are numerous OTC remedies in wide use in the form of various powders which are mixed with water or juice, and tablets. Fiber works with the body's natural movement of stool through the bowels by increasing bulk. It needs to be used regularly and is not a panacea for acute constipation.

Prunes and Prune juice: perhaps the most commonly used home remedy is a dose of prune juice taken in the morning. For some, stewed prunes is a regular feature at breakfast as a way of maintaining regularity.

Stool Softeners: Colace (docusate sodium) and Surfak (docusate calcium) are reasonably effective stool softeners. They come in liquid and gel cap forms, are taken once or twice daily and help to soften stools, making them easier to pass.

Senna: senna is a natural fiber that is the primary componant of several bowel remedies. It is available in pill form and liquid (Fletcher's Castoria).

Bisacodyl: available in oral and suppository forms. The pills are slower acting but more gentle, never mind less embarrassing. Widely used and effective. See further information about suppositories below.

Castor Oil: an old remedy replaced by less noxious medications. Castor oil works quickly so should not be taken at bedtime. For many the taste alone, reputed to be awful, is reason enough not to even consider it. Chilling it and mixing it with juice may make it easier for the patient to accept it. It is derived from the castor bean, which grows mainly in tropical regions.

Mineral Oil: a petroleum byproduct mineral oil is useful as a lubricating laxative that inhibits the absorption of water from the feces, helping them to pass more easily. It is normally effective within 6 hours of being administered. It should not be used for small children and anyone with a cough or who has trouble swallowing because of its potential to cause pneumonia should it reach the lungs.

Epsom Salts: otherwise known by the chemical name of magnesium sulfate, epsom salts are a fast acting laxative. 1 teaspoon mixed in 3-4 ounces (45-60 ml) of water.

Suppositories: suppositories are a form of medication delivery that places the medication where it will presumably act directly upon the problem area. Common compositions include glycerin or bisacodyl, which are classified as stimulant laxatives. They are placed in the rectal vault and act locally rather than systemically.

Exercise: as mundane as it may sound simply increasing activity by walking can sometimes benefit the person who is otherwise having a difficult time experiencing a bowel movement. In some cases gravity and natural movement are all that is needed.

Enema: an enema is the introduction of fluid into the rectum for loosening formed stool and stimulating the expulsion of same. The equipment used is simple and the technique easy to learn. It remains widely is use in hospitals when other efforts fail.

An old favorite is the M & M (Milk and Molasses) enema. 1 cup milk + 1 cup dark molasses mixed together over low heat until well blended then cool to room temp.

Apple Delight: mix together equal amounts applesauce, prune juice and bran. Start with 1 tbsp (15 ml) twice daily, increasing the dose 1 TBSP at a time after two days: 2 tbsp AM, 1 tbsp PM...2 days later 2 TBSP BID....if no result try 3 tbsp AM, 2 tbsp PM...etc ---most patients will be regular with this regimin.

Digital Removal: finally, the ultimate in last resorts. Simply stated it means inserting a gloved (and lubricated!) finger into the rectal vault and digging out impacted stool that may be too firm for the patient to expell naturally. Once the plug is removed natural expulsion usually follows.

Coughing

Not only is this an issue of comfort but also it is of concern with regard to the spread of germs. Coughing can expel mucous from the lungs as well as droplets from the upper respiratory tract, the latter which may linger in the air for several minutes with significant potential for infecting others breathing the same air.

There are several ways to address this problem:

Cough Syrup: There are several types of cough syrup available. The most common contain ingredients to inhibit the cough reflex (Dextromethorphan) and to loosen the mucous (Guafenisin) in the respiratory tract. Remedies can also be obtained which contain one or the other but not both. Which to use depends on whether you are trying to tame a persistant cough or make it more effective.

Simple home remedies have probably been around for as long as man has been bothered by the common cold. A very common one follows:

Home Cough Remedy: 1 teaspoon of honey
1 tablespoon of lemon juice (ideally fresh squeezed)
Stir mixture in 3-4 ounces (45-60 ml) of drinking water and consume.
May be taken 5-6 times a day as needed.

Vicks Vapo-Rub: A commercial compound with a long history the active ingredients are camphor, eucalyptus and menthol. It is rubbed in a thick layer on the chest and throat to provide cough relief and may be used three times daily per manufacturer's instructions. It is the vapors released from the medication that relieve the cough; it does not absorb into the lungs through the skin.

Vaporizers: Steam vaporizers are very easy to improvise, requiring only a heat source and a kettle to contain water which is heated to the point that it steams steadily. If the patient is able to sit upright they can bend over the steam with a towel or light blanket draped over their head and shoulders to contain the vapors. The vapors help to loosen phlegm in the lungs and air passages, making subsequent coughs more effective in ridding the body of the material and reducing the need to cough.

Splinting: Though it does nothing to relieve the cough itself in some instances the patient is reluctant to cough because of the strain on the abdominal muscles. Holding a pillow firmly across the abdomen using both arms can help alleviate some of this strain and make the cough more effective, therefore reducing the need to cough as often.

This can also be of benefit in cases where there are rib fractures. The splinting helps to reduce the motion of yet non-joined fractures or cartilage separations.

Long-Term/Chronic Care

In a situation where eventual access to outside assistance is not foreseeable there may come a point where care converts from that aimed at recovery to simply providing on-going care for a chronic condition. Whereas in cases of recovery care, or sub-acute care, we center our attentions around rebuilding the patient's health, here we are concerned with maintaining a level of health when further recovery is not likely. This does not automatically imply that the person is an invalid but rather than their

condition has stabilized and they have achieved as much healing as they are ever likely to, absent a fully functional modern healthcare facility.

Some injuries or ailments simply cannot be fully recovered from under austere conditions, whereas others may require additional weeks or months of low-level care, such as recovery from a major long bone fracture or a spinal fracture that does not result in a functional deficit. The result may be the need for reduced but nevertheless continuing care requirements. The patient may be confined to the house due to impaired mobility, for instance. Even when able to move about with a wheelchair, they still run the risk of future impairments due to their lack of full mobility.

For our purposes, we are assuming, if the condition is such, that the person will eventually recover to the point that they are able to assume responsibility for most of their own care. They may still require assistance with such activities as preparing food, bathing and getting into and out of bed, but are able to feed themselves and move about with the aid of assistive appliances (wheelchair, crutches, cane, etc.). A person who is truly bedfast and totally dependent upon others for all of their activities of daily living (bathing, eating, elimination, dressing, etc.) will not likely survive long, succumbing eventually to infection or the effects of chronic immobility. While we intend to do what we can within the means available to us we must also face the possibility that some people will die no matter how attentive to their care we are. In this respect, austere nursing care is no different from that of the present day.

Following are a list of potential conditions which the prevention of tops the list of concerns.

Bedsores:

One of the greatest challenges any austere nurse will encounter will be the problem of pressure sores. Hospitals today wage a continuing fight against the effects of unrelieved pressure against the skin and all the attendant problems it causes. As we gain understanding of the mechanism behind the problem and evidence gathers re: which treatments work vs. those that show little benefit, we gain ground in the overall fight. But the problem will never go away completely. Given that austere nursing care presumes resources will be limited and overall health potentially sub-optimal, we need to operate from the premise that given enough time and patient population, we will see and need to treat pressure sores.

Sometimes referred to as decubitus ulcers, they result from the pressure caused by the body resting on the same point(s) without shifting the weight off the point(s) of contact. This causes pressure on the tissues to the point that arterial blood flow is impaired. It is the lack of blood flow to an area or region that causes necrosis, or tissue death.

They are common in people who use wheelchairs or who are bedridden even for relatively short periods of time such as following a surgery. In addition, persons who are emaciated, paralyzed or who suffer from decreased sensation are at greatly increased risk. Key areas prone to development of pressure sores include the hips, the points of the pelvis to the rear (the ischium), the sacrum (base of the spine), heels, and the shoulder blades.

General precursors to bedsores can be easily identified:

Elderly

Bedfast or wheelchair-bound
Unable to move certain parts of the body without assistance due to injury, illness or weakness
Incontinence of bladder or bowels: moisture next to the skin can cause breakdown over time
Fragile skin due to age, disease or injury

Bedsores are categorized by severity from Stage I (early indications) to Stage IV (worst).

Stage I: A reddened area on the skin that, when pressed, is "non-blanchable" (does not turn white). This indicates that a pressure ulcer is starting to develop.

Stage II: The skin blisters or forms an open sore. The area around the sore may be red and irritated.

Stage III: The skin breakdown now looks like a crater where there is damage to the tissue below the skin.

Stage IV: The pressure ulcer has become so deep that there is damage to the muscle and bone, and sometimes tendons and joints.

Once a bedsore has been identified treatment must begin immediately to avoid further degradation of the tissue:

- Relieve pressure to the area using pillows, foam cushions or sheepskin
- Moisture barrier ointments such as Calmoseptine will be of significant benefit for Stage I or II sores only. Coating the area with talcum powder or a similar product before applying the cream will allow it to be cleaned off easier and will also help dry the skin underneath of the barrier coating. Solid cooking shortening (Crisco) or even lard can be used in the absence of medical creams. Petroleum jelly, however, should NOT be used. The ointment or cream selected should be applied at least twice per day and perhaps as often as every 4-6 hours if the patient is frequently incontinent of urine.
- Improve nutrition. A good multi-vitamin at a minimum should be part of the care. Zinc supplements are also very useful in preventing skin breakdowns.
- Keep the area clean and free of dead tissue. Use salt water to cleanse and gently remove dead tissue. Never massage the area though as it can damage the sensitive tissue underneath.

Prevention is the key. Check daily for reddened areas that do not blanch (turn white when pressed), blisters, sores or craters. Other useful measures include:

- Change position every two hours to relieve pressure.
- Use items that can help reduce pressure -- pillows, sheepskin, foam padding or semi-firm air mattress (never allow the person's skin to lay directly on a vinyl mattress though. The sweat buildup will itself cause further problems).
- Eat healthy, well-balanced meals.
- Exercise daily, including range-of-motion exercises for immobile patients.
- Keep skin clean and dry. Incontinent people need to take extra steps to limit moisture.

Tincture of green soap is an older remedy used to toughen skin in order to make it less prone to breakdown. It is a combination of vegetable soap, lavender oil, glycerin and ethyl alcohol that is biodegradable, mildly antiseptic and a good skin degreaser. It is used by applying it straight to the skin surface to be treated.

Deep Vein Thrombosis:

More commonly associated in the lay press with "economy class syndrome" from air travel, deep vein thrombosis is a common cause of death for bed-bound patients. It occurs primarily due to prolonged immobility and is worsened by conditions such as lower limb fractures, cancers, and poor circulation in the legs (common in older diabetics) or a genetic predisposition to developing blood clots. Clots form in the veins of the lower leg or pelvic region and travel to the lungs when they break free. This latter condition is known as Pulmonary Embolism, and represents a life-threatening condition for which there is little recourse in the austere environment. Thus, it is in our best interests to ensure that the original clots are never given the chance to form in the first place.

The symptoms of DVT include leg pain and tenderness to the muscles of the calf. Additionally, the affected leg may swell or change color to a purple or blue shade. The symptoms may occur suddenly or develop rapidly over a short period of time.

The best treatment is prevention. Where possible even significantly unwell patients should be mobilized several times a day somehow – the benefits of bed rest need to be balanced against the risks of developing clots. They should be encouraged to get up and walk several times a day, as they are able. Patients should not cross their legs in bed and massage and stretching of the legs should be performed 3-4 times per day as a minimum.

The legs should be elevated higher than the level of the heart. Use pillows or folded blankets. Compression stockings, if available, work well and are a standard of care in hospitals. Absent these specialized garments Ace wraps may be pressed into service. They should be wound firmly but not so much as to cause discomfort or to impair circulation.

The best preventive treatment is daily injections of subcutaneous heparin – but this won't be an option for most. In the austere environment, aspirin therapy represents the best option likely to be available. Though far from optimal it is the best we have available. 81 mg ("baby aspirin") taken by mouth daily may help with prevention when combined with the other measures mentioned above.

Contractures:

This refers to the tightening of the non-bony tissues of the muscles, skin, ligaments or tendons. Unless promptly addressed the condition will become permanent. The primary symptom will be loss of motion in the affected joint(s), eventually followed by unrelenting contraction of the muscles. Depending on the affected extremity the arm may draw inwards, the leg will curl back into a fetal-like position, or the hand will develop a claw-like appearance. Once well established the limb cannot be straightened even by the care provider.

Predisposing conditions include burns, trauma, immobility and deformity. Age itself plays only a very small role. Anyone who is bedfast and who does not possess voluntary movement of their limbs can develop this condition if their muscles and joints are not exercised by stretching and bending.

Prevention is the key to avoiding this condition. You will need to implement a program of early movement and physical therapy in cases of acute or orthopedic injury. Each joint should be exercised separately. In the case of the leg, for instance, the toes, the ankle, the knee and the hip should all be addressed individually.

Pneumonia: Anyone who is bedfast for longer than a couple of days, and who is not otherwise able to sit fully upright for regular periods of time is at risk for developing pneumonia. In particular the risk for aspiration pneumonia - caused by the patient inhaling food or fluid into the lungs – is significantly greater owing to their reclining position while swallowing.

F. Q's and A's:

Thermometers

Q: How do I use a mercury thermometer?

A: Grasp it by the head and shake it in a downward, flinging motion to cause the mercury to settle towards the bulb end. You want it at about 92-94°F – approx. 33° Celsius – before using. The bulb end is then tucked into one of the pockets under either side of the center of the tongue and held there with lips closed for 5 minutes in order to obtain an accurate reading. This is considered to be an accurate core temp, or equal to the actual temperature inside the body itself. Avoid taking the temp immediately after drinking. A normal temperature is 98.6° F.

Q: What about rectal thermometers?

A: They should be shaken down to the same level and then inserted very gently (use water-soluble lubricant or petroleum jelly, and ideally a plastic sheath) into the rectum. 1 inch is sufficient for infants, 2 inches for adults. Accurate temps are obtained after 5 minutes. Rectal temps are generally considered to be 1 degree F warmer than the true core temperature so subtract 1 degree from your reading. Avoid taking the temp immediately after activity, a bowel movement or a bath or shower.

Q: Can I take the temp under the arm?

A: Yes, using an oral thermometer. Prepare it the same way by shaking it down then placing in the pocket of the armpit with the arm held down to the side. Obtaining an accurate axillary temp takes 11 minutes. Axillary temps are 1 degree F cooler than a true core temp so add 1 degree.

Q: Which site is best?

A: The mouth gives the most accurate core temp reading, and also reacts faster to rising temps than either the rectal or axillary sites.

Q: What is considered a normal healthy body temperature?

A: 98.6°F (37°C) is generally considered to be ideal, with 98.0°F to 99.0°F the generally accepted "normal" ranges for healthy persons. In the elderly 2 degrees below "textbook" may be their actual normal body temperature. Thus 98.6°F may actually represent a fever in some people in these individuals. The key is knowing what is normal for that person.

Q: What about abnormal temps?

A: 105°F is very high in an adult, potentially life-threatening. In that range damage to the brain, blood, muscles and kidneys is increasingly likely. Anything over 101 degrees should be addressed. Small children may spike temps of 105°F and even 106°F for short periods and not suffer ill effects, but as we age our tolerance for fever decreases. 103 is very high in the elderly and cause for serious concern, whereas for most adults and even children 104°F (40°C) is still relatively safe but bears close watching. In any event active cooling measures should be undertaken before it reaches that level if possible.

Fever

Q: How do I reduce a fever when I don't have medications available?

A: Think in terms of the body's natural cooling mechanisms and make use of them. The human body cools itself by evaporation (sweating), radiation (giving off heat from the body surface) and conduction (transferring heat from a warmer to a cooler surface).

The first thing that can be done is to reduce the coverings over the body, such as clothing and bed linens. This allows for cooling via radiation. Expose as much of the patient's body surface as practical to open air.

The two most commonly used non-pharmaceutical mechanisms used to reduce fever can be classified as wet and dry treatments.

Wet treatments include sponge baths, cool compresses and alcohol rubs. By wetting the body surface they increase evaporative heat loss. These work best when the humidity level is 90% or below. Alcohol rubs, while they do cool the body, should be regarded as a last resort. This is because the alcohol can be absorbed through the skin. With children this can be dangerous, and it can cause problems with adults as well. ONLY common rubbing (isopropyl) alcohol should be used.

Dry treatments include ice bags and chemical cold packs. The body itself is not made wet; instead cooling is effected by conduction. Place them in areas of the body where arteries run close to the surface, such as the armpits, in the groin region, and behind the knees.

A wet method of cooling via conduction is to partially immerse the body no deeper than mid-chest in tepid water (approximately 80-85°F/26-29°C). Cold water may cause the body lose too much heat, causing the opposite of fever, or hypothermia. If the water causes shivering, the temperature may actually rise instead.

Giving Medications

Q: Why are injections better than tablets?

A: The short answer is they are not always better or even preferred. Injections are useful when your patient cannot swallow, is prohibited from taking anything by mouth or you want the medication to work quicker and achieve higher blood levels (i.e. antibiotics in serious infections). For most patient's tablets are fine.

Q: Can I crush tablets and dissolve them in water or put them in jam?

A: Most of the time. Generally, the only tablets which shouldn't be cut up or crushed are slow release tablets (SR = Slow Release; CR = Controlled Release; SR = Sustained Release) – these are designed to release the drug slowly over a period of time and part of that mechanism is destroyed if the tablet is crushed or broken. Enteric, or coated tablets, can be crushed but with the caveat that the result may be distress to the stomach. Aspirin and ibuprofen are examples of coated medications that are designed that way to increase comfort.

Q: Can I use crushed or powdered medicines as an injection?

A: No. Injections are formulated with an eye towards pH factors and the size of the dissolved solids. Merely because a medicine has an injectable form does not mean the solid form can be dissolved and injected.

Q: What can I do for someone who has trouble swallowing pills or capsules that shouldn't be crushed or broken?

A: Placing them in a bit of jam or crushed fruit such as apple, pear or guava (avoid citrus fruits as the acid content may interfere with the medication) and administering them by spoon seems to work for most people.

Q: How do I administer injections?

Information on giving injections can be found in any basic medical or nursing book. This is simply an overview. There are 3 common sorts of injections.

- Subcutaneous – into the subcutaneous layer under the skin using a small short needle (24, 25 or 26 ga by 1/2 or 5/8 in./1 cm). This is very easy to do and the medication is reasonably rapidly absorbed. This route should be avoided in patients who are shocked and with medications which are strongly chemically irritant e.g. most antibiotics.

- Intramuscular – into a large muscle using a longer larger needle (21, 22 or 23g). The best location for the inexperienced in into the large muscle bulk of the upper outer aspect of the thigh. Intramuscular injections are reasonably rapidly absorbed, but provide a degree of sustained release effect. Muscle can tolerate more irritant medications (e.g. most antibiotics) but some drugs can cause significant muscle damage if given by IM injection e.g. thiopentone

- Intravenous (IV) – into a vein. This is the most rapid route of administration and gives the greatest clinical effect. It is much easier to slowly adjust the dose of a medication using the IV route, but the effects of giving too much of a drug are much more pronounced. IV access is also the most difficult to establish and requires special equipment and practice.

There is a danger of allergic reaction anytime a medication is given but it is most pronounced with IV administration. Anytime you administer a medication you should be prepared to treat an allergic reaction. Most are simply a red itchy rash or facial swelling. Usually they are self-limiting. Occasionally the reaction is more severe and evolves to an anaphylactic reaction – involving severe abdominal pain, vomiting, difficulty breathing, low blood pressure and/or swelling in the throat. This is life threatening and is treated with an SQ (subcutaneous) injection of adrenaline, followed by oral Benadryl (diphenhydramine). Management of this is well covered in the main references.

Q. How do I administer a suppository?

Suppositories are inserted into the rectum by placing the tip against the anal sphincter and pushing with a finger. Water based lubricant such as KY Jelly can be used to make insertion easier but Vasoline (petroleum jelly) should not be used.

Measuring the Pulse

Q: How do I check the pulse?

A: The pulse can be checked at the vertical notch of the neck next to the throat (carotid artery), the inside wrist (radial artery), in the groin, behind the knee, and on the top of the foot. As a rule of thumb, the weaker the blood pressure, the higher you'll have to check for a pulse, though there is no concrete rule indicating what level of blood pressure will result in a pulse at what site. A pulse can also be heard using a stethoscope placed over the left chest above the heart (called an Apical pulse). Either count for a full minute, or for 30 seconds and multiply X 2, to determine the pulse rate. Pulses are always expressed in beats per minute.

Q: What is a normal pulse rate?

A: This varies widely amongst any population, depending upon the presence of pre-existing disease, physical conditioning, whether the person was at rest prior to assessing the rate or recently active, and more. As a general rule pulses between 60 and 100 are considered normal for most adults. Normal rates are best determined in the absence of pain, illness and injury, while the person is at rest. Absent that you will need to measure the pulse rate over a period of time to arrive at a likely norm, with significant variances from those indicating potential problems.

Weight

Q: What does short-term weight loss or gain indicate?

A: This may mean a gradual change in fluid retention or loss, or poor nutritional status. Look for additional clues such as fluid intake exceeding output by more than 20%, or loss via urination exceeding intake by the same amount. Likewise match weight loss or gain over a period of weeks to nutritional intake. Ideally weight fluctuations should not exceed +/- 1 pound (0.5 Kilos) per day in an otherwise healthy individual whose fluid and nutritional intakes are in balance with body requirements.

Q: How do I measure the weight of someone who is unable to stand unassisted?

A: Perhaps the simplest method is to use a chair. Place a platform on the scale to hold the chair, then the empty chair itself. Weigh this and write it down. Now place the patient in the chair and weigh them. By subtracting the weight of the empty chair, etc. from the total you have the weight of the patient. Make sure you use the same chair, etc. each time or your results will be in error.

Elimination Needs

Q: What are the basic tools needed to address bodily elimination needs?

A: The primary tools are the bedpan, the urinal, the rectangular basin, and the hot water bottle. Virtually all elimination needs can be addressed with these items and a few accessories such as soap and washcloths. Bedpans come in two basic forms, the wedge-shaped fracture pan and the traditional deep bedpan. Urinals are used mostly for male patients; though specially designed female urinals are available, they are rarely seen. The rectangular basin serves as a multi-use container for washing and emesis catchment. It is far less prone to spilling than kidney-shaped emesis basins and also eliminates one extra item from your inventory. Hot water bottles serve well as reusable enema bags as well as other uses not specifically related to elimination.

Q: Which is better, a fracture pan or a regular bedpan?

A: Fracture pans are usually the most convenient for women and children but they are limited in capacity and tend to spill more easily when removed. A traditional deep bedpan is more comfortable when fractures to the hips, pelvis or upper leg or back pain are not involved. In such cases a fracture pan, which is wedge shaped, is more comfortable for the patient. Males will find either style usable with the previous caveats in mind.

Q: What about someone who can stand but isn't able to walk to the toilet?

A: A bedside commode can be fashioned from a sturdy chair that has had an oval or round hole cut in the seat and a basin affixed underneath that can be easily removed for emptying. When properly placed at the bedside the patient can stand, or be stood with assistance, pivoted and sat upon the chair. Arms

on the chair will make movement easier for someone who can support him or herself using their upper body but may interfere with their ability to transfer onto the chair.

Q: How about urinals?

A: Urinals are used most often by male patients for urine elimination. They can be readily improvised from a coffee can or jar though the manufactured version is designed with an angle to the neck so that urine does not spill when the device is used. For male patients and caregivers alike, they are easier to use than a bedpan. Female urinals are rarely used but are available. The bedpan is normally used for women.

Q: What is the best way to handle vomiting?

A: While so-called emesis basins (kidney-shaped plastic or metal pans) are available they are of limited capacity and spill readily. Better suited is a basin of approximately 6 inches depth and rectangular in shape. It holds more and doesn't tend to allow a forceful vomit to splash out of the container.

Another alternative is a plastic bag such as a small dustbin or wastebasket liner. A 6 or 8-inch diameter embroidery hoop will hold it open and give the patient something to hang on to. To close it merely grasp the bag with one hand and twist the hoop around with the other. Once removed from the hoop frame, it can be sealed using string or a metal twist-tie. The plastic bag has the advantage of being flexible and semi-spill proof, as well as easily disposed of.

Another expedient holder is a wire coat hanger pulled open to form a diamond shape to which the plastic liner has been securely taped.

Q: What about underpads?

A: Underpads, or incontinence pads, are reusable mats made of absorbent material – usually cotton with a moisture-proof backing – that are placed underneath the patient to catch and absorb urine. They also prevent feces from contaminating bed linens and make cleanup easier. Underpads can be improvised by placing a plastic sheet inside a folded sheet or a blanket.

Q: Aren't there disposable ones too?

A: Yes, often referred to by the now generic term "chux", they are intended for one-time use then disposed of. While they work well within their limits, perspiration alone can render them ready for disposal, causing the expenditure of large quantities in a very short period of time.

Q: Can you explain what you mean about hot water bottles?

A: Sometimes referred to as an enema syringe or a douche bag, simply described it is a latex rubber or soft non-rigid plastic bottle with a stopper that either seals it completely or allows attachment of a hose, which in turn is fitted to one of an assortment of tips designed for differing purposes. Used to administer an enema, for instance, one would fill it with the solution of choice such as warm water and soap suds, introduce the proper tip into the rectum, and allow the contents of the bag to flow into the rectum by gravity feed.

Q: What about cleaning the patient up afterwards?

A: Soap and water combined with a washing cloth or sponge work best. A gentle, non-irritating soap without added antibacterial agents is all that is needed. You may also wish to consider using commercially available pre-moistened cloths (also known as baby wipes, etc.). These are simply pre-wetted disposable cloths that may be used to clean up feces, urine, and emesis. Large sizes are available for health care use but the smaller version made for cleaning up babies will also suffice. Good quality paper towels can used to fashion wipes by adding soap and water to a basin, tossing in the paper towels to absorb the mixture, and then wringing out the excess water and placing them in plastic bags for later use. Do not overlook toilet tissue as the most basic aid to cleaning up.

Remember: urine, feces, and emesis are all potential disease carriers. Therefore gloves for the caregiver are a must. You will use more gloves for purposes of cleaning up patients requiring hygiene assistance than you are ever likely to use for addressing wounds or performing other procedures. The bedpans, urinals, and basins themselves should be cleaned with soap and water at a minimum after each use and set out to dry or they will become a source of unwelcome odors. Chlorine bleach used before the soap and water rinse works even better.

G. Caring for the Caregiver

As odd as it may sound you, as the caregiver, also need to care for yourself. A romantic notion of selfless sacrifice and working tirelessly and endlessly until all are provided for is not a reality we are likely to see in this world. Exhaustion is a very real possibility. And with exhaustion in the physical sense also comes exhaustion of the mind.

Professional nurses suffer inordinately high rates of turnover, or "burn-out", due to the increasingly high demands of their occupation and patients who are sicker by the time they are hospitalized. While much of this is due to changing regulations enacted by health care insurers and employers seeking better profits, it nevertheless behooves us to recognize that austere nursing care in times of calamity or isolation can bring about many of the same feelings of frustration and hopelessness. Whereas the career Nurse has the option of seeking out a different employer or moving to another specialized care area you, as an austere nursing care provider, won't have that option.

Mankind has a long-standing tradition of taking care of its own within the circle of family and friends. Younger family members may provide care for a disabled parent at home, or for a sibling child born with handicap that prevents them from venturing out into the world save on a limited basis. In doing so they may perform many of the basic functions detailed previously in this chapter. Even though it be a labor of love if not practical necessity, there often comes a time where the caregiver reaches the point of emotional, if not actual physical exhaustion.

Recognizing this phenomenon, other caregivers developed what has been come to be known as the respite program. Respite care is simply that, provided on a temporary basis - a few hours, days or even a limited number of weeks – so that the primary caregiver may themselves rest from the emotional if not physical toil which has occupied them daily for long periods of time. The patient – their family member – is taken care of by others during this period.

Likewise, the austere care nurse needs to develop a plan for his or her own respite. Should you find yourself working alone you need to set aside time for personal relaxation. Take care of elimination needs, administer medication if called for, provide supportive or therapeutic care as called for, and then tell your patient(s) that you will return or otherwise be available after a specific time interval – be it 15 minutes or an hour - and then use that time to recharge yourself. Have a cup of coffee or tea, take in some light nutrition, or just read a book or spend time stroking the cat; whatever you choose, relax.

Pacing Yourself

You will do your patient no good if you work to the point of exhaustion. Learn to sleep when your patient sleeps. Have someone else watch over the patient while you sleep if you can't arrange to sleep when your patient does. The helper can notify you of any emergency or other need such as pain medication.

Establish a routine. If the patient's condition is acute but not urgent and regular vital signs are called for, set a schedule. A generally accepted standard is every 4 – 8 hours. For more serious cases whose condition may change regularly, use the shorter interval, such as trauma cases or very acute illness. For a patient who is recovering, usually every 8 –12 hours is frequent enough unless there is an unexpected change, at which time you may want to reassess the current vital signs.

Look for shortcuts. Instead of placing the patient in bed fully clothed, provide them with a modest cover. This facilitates faster access for dressing changes and elimination needs and also reduces the laundry load. Try arranging the schedule of cares so that you can accomplish several tasks in one visit to the bedside. If caring for several patients at once, schedule their cares in blocks of time that allow progression from one individual to another once the bulk of the needed treatments have been completed.

Place a hand bell or other audible signaling device where the person can reach if it they need something. Arrange a pull cord so that a bell will ring when assistance is required. This will allow you to tend to other patients or even to spend much-needed time away from the sickroom without the patient lacking for attention when required. Have a family member or friend sit with them and provide simple services such as adjusting bedding and pillows, or feeding them, or assisting with simple tasks that do not require a trained caregiver.

Focus on effect and outcomes instead of perfect technique. Instead, strive for reasonable competence. For persons formally trained in nursing technique, this may represent a major mental obstacle to overcome. Lack of the tools and on-call resources that are routinely at our disposal in a modern, working healthcare system can be frustrating at best, and emotionally disabling if we dwell upon what we do not have versus what is available. It is possible to immobilize oneself by dwelling on what we do not have instead of finding strength and reassurance in what we do have.

In providing nursing care in the austere environment, we need to focus on the patient first and foremost. There should be no artificial schedules such as demanded by an institution. Your actions should be focused on the one or few patients under your care. Medical-legal concerns should be far removed, if they even have a place in the world in which you practice. Instead, ethical concerns should take priority as they did decades ago when medical care was seen more as a humanitarian rather than financial concern.

The one overriding consideration that needs to be reinforced is this: model your care around that necessary for the comfort and recovery of your patient(s) and not around any medical-legal model of what care should be for a given case. Base your actions on what is in the patient's best interests at all times. Do no harm. Know what is harmful, and proceed accordingly.

Chapter 21: Botanical and Herbal Medicine

The note before the note. This chapter was originally written by an experienced prepper, farmer and herbalist who was known by her internet name of Goat-lady. Unfortunately, Norma died between editions of this book. We have left this chapter unchanged as a tribute to Norma and her hard work in helping us with the second edition and we think it still stands with no modification. BCE

(Note. The following is an introduction to Herbal and Botanical Medicine with a special orientation to preparedness and survival situations. It is written by an author with an interest in herbalism and preparedness. It is offered in good faith. The scientific evidence supporting some of the botanical preparations mentioned here is variable – from strong evidence to anecdote. The "bible" on scientific herbalism is ***"Medical Botany: Plants Affecting Human Health"*** *by Lewis and Lewis, Published by Wiley 2003. This book deals in-depth with the evidence base for botanical medicine and cannot be recommended highly enough. It is not "how-to" book but a scientific treatise on the subject.*

We strongly recommend you consult a reputable herbal identification and medicine text prior to undertaking any treatments discussed here. Also note that this section has a slight North American bias due the chapter writer's location, but much can be generalised)

Many of the present-day pharmaceuticals were derived from botanicals or herbs. They can be very complimentary to conventional medications and have a valid track record of treating, easing, and resolving many diseases. While some may have not therapeutic effect at all the reason most have been used consistently for centuries by various cultures is because they work – the efficacy may vary, but they do work to some degree or another. The incidence of serious side effects with herbs and botanicals appears to be low although like anything taken excessively or misused can result in serious adverse effects. There is also a small potential for interactions with conventional medication, and botanical medicines should be prescribed with the full knowledge of other medications the patient is taking.

Botanicals and herbs work in several complimentary ways. Firstly, they can treat illness and disease directly as with most medications. Many, however, work at building the body's natural defences and affect the more root cause of disease. Most botanicals/herbs work slowly with the body and do their work for the most part gently, unobtrusively, and supportively.

To utilise botanicals/herbs in a survival situation you need to plan ahead. Botanicals/herbs are not just another "prep" item to add to your list - planning ahead in this case most certainly will involve a little more work and time than just buying what you think you need and storing it away.

Botanical/herb therapies and treatments seem to lend themselves more to a "Bug In" situation rather

than a "Bug Out" scenario mostly because it would be difficult to have the added weight of a couple of quarts of tincture in your pack and in a long term lack of conventional medical facilities in order to continue to have the botanicals and herbs available you really need to grow them or know where to gather them in your local area.

We strongly suggest you get at least one really good medicinal herb identification book. These are available for most countries and areas. A useful series of books in the US are the Peterson Field Guides. The older editions were two books; one for the Eastern U.S. and one for the Western U.S. There are now newer editions: A Field Guide to Medicinal Plants and Herbs of Eastern and Central North America by S. Foster and James Duke and A Field Guide to Western Medicinal Plants and Herbs by S. Foster. There many other excellent guides available some very localised to specific areas.

There are two excellent books focusing on the pharmacology of botanical medicines. In addition to these textbook styles there are many other excellent books on herbal medicine although there is some significant variation in how strong the science behind the books are. Don't buy any book blindly, get your local library to special order books for you to read, and then decide if that one would be of use to you.

The next step is becoming familiar with what is growing wild in your local area. It can be as simple as taking Sunday afternoon nature walks with the family starting in mid to late spring. Do this again in early summer - same areas as before. As you identify herbs/botanicals make a mental or even paper map of these locations. Do your walk again in late summer/early fall and check locations because many herbs and plants need to be harvested before flowering, or after flowering, or after having died down. If you don't have a location map you may not be able to find that clump of purple coneflower (Echinacea) when it has no leaves and no purple flower.

A. Preparation of fresh botanicals and herbs for storage

Leaves: Harvested botanical and herb leaves are traditionally dried to concentrate the medicinal properties. If you have a gas stove with a pilot light in the oven just spread the leaves 1 layer thick on cookie sheets and put in the oven. The heat from the pilot light will dry the leaves perfectly in a day or so. Check the progress and remove leaves from the oven when they crumble between your fingers. You can also use a food dehydrator with the thermostat set between 250-275 degrees F. Overnight is usually enough.

For fat, thick, juicy type leaves such as mullein or comfrey, tie the leaves in small bunches (about 4-6) and hang from a line or rack in a dark warm room.

Another option is to make drying screens out of 1 x 2s - any size you like - covered with old plastic screen material, attach lines to the corners, and attach those lines to hooks in the ceiling of a dark, warm room. You can use these same screens to air dry outside but not in direct sunshine. Slow and gentle are the bywords for drying herbs. High humidity will slow down the process.

Store your dried leaves in quart-sized Zip-lock bags with air in the bags or tightly capped jars in a dark place. You do not want to crush the dried leaves at this stage. Be sure and clearly label as to the herb and

year harvested. Most dried herb/botanical leaves will maintain their potency for 2 years this way.

Roots/Bark/Twigs: Roots, bark, and twigs are traditionally dried. You should chop the fresh root, bark, or twigs BEFORE drying. A dried whole root or twig resembles a wrinkled railroad spike and is just as hard; they can be impossible to chop or crush if dried whole.

Wash the root clean of dirt with cool running water, chop, and dry using the same techniques as for leaves. It takes twice as long to dry roots and twigs. There should be NO moisture in the dried root/twig/ bark or it will mould and be useless. I usually try to split open a piece of root/twig with a sharp knife - if it cuts open easily it's not dry enough yet.

Flowers: Harvested flowers are traditionally dried. Just spread the flower heads out and dry using the same as the leaf drying techniques. Store the same as leaves.

Whole Herb: Occasionally the whole plant may be used in formulas. In that case just hang the whole plant upside down in a dark, warm room until the main stem snaps.

B. Medicinal Botanical Preparation Methods:

Having gathered your dried herbs and botanicals, what do you do with them to be able to best use their medicinal components? Keep in mind that botanical and herbal preparations are not made and used with precise measurements or dosages. Herbs and botanicals vary greatly in the potency of their medicinal components due to weather, growing conditions, and soil conditions. The traditional measurements/dosages are used primarily based on the minimum found to be effective. There are a few herbs/botanicals which are toxic or can cause negative reactions due to an overdose. There is a degree of trial and error with dosing. You should initially be conservative in your initial dosages.

Water Infusions/Tea: Medicinal teas are a time-honoured, traditional usage of herbs and botanicals. It is an easy way to treat children or someone who is very ill. A preferred method is to get one of those silvery tea balls, stuff it full of crushed, not powdered, dried herb, put it in a cup, pour boiling water into the cup, let sit (steep) covered if possible, for about 10 minutes. Add some honey if sweetener is needed and sip away. The dosage varies with the herb, but a cup 3-4 times a day is reasonably standard.

Medicinal teas must be very strong in order to be potent. They frequently taste very bad. The exception to this would be using a very mild herbal tea for infants and children - smaller body mass and weight so teas need to be less strong and ,therefore, more palatable for them.

If the tea you want to use needs to be used throughout the day, make up a quart jar full using 1 tea ball

of herb per cup of water, strain after steeping if using loose herbs, and it's ready for use when needed for the day. It will keep safely 24 hours without refrigeration, 2-3 days with refrigeration.

Oil Infusion: Oil infusions are handy for skin infections, itchy, dry skin, burns, and as ear drops. Take dried herbs, crush (not powder) put enough in a glass baking pan to cover the bottom thinly, and cover the herbs with olive oil. Olive oil will not go rancid so you can make this ahead of time and store on the shelf. Stir the oil and herbs to make sure all herbs are coated with oil, then cover with more oil to at least 1/2 inch. If you have a gas stove with an oven pilot light just leave the pan of herbs and oil in the oven overnight. Alternatively, set the pan of herbs and oil in the sun for about 2 weeks with some sort of lightweight fabric covering it to protect from bugs. Strain the oil out through a cloth with a tight weave, bottle it, and use as needed topically.

Salve: Herbal/botanical salves are just an oil infusion hardened with beeswax. You need lots of the oil infusion. Put the oil infusion in a glass or stainless steel cooking pot and heat gently. Add chopped/shaved beeswax to the warmed oil; usually 2oz beeswax per cup of oil. When the beeswax is melted place a few drops on a saucer, let cool, and touch it. If it is too soft, add more beeswax to the pot; if too hard add a bit more oil to the pot. The perfect salve should stay hard for a few seconds as you gently press your finger on it then suddenly soften from your body heat. Pour into appropriate containers for use as needed.

Decoction: Decoctions are herbs/botanicals prepared in boiling water used primarily for compresses and syrups. If you have NO taste buds it can be drunk! Use approximately a heaping palmful of dried, crushed (not powdered) herb per pint of water. Boil together for about 15 minutes, cool, strain and add sufficient water to bring the volume back to a pint. For compresses just soak a sterile dressing in the liquid and apply to the body. To make a syrup, add sufficient honey to thicken and make palatable. Good treatment for sore throats.

Steams: Steams utilise the inhalation route. Put 1-2 hands full of dried, crushed (not powdered) herb or fresh (best if available as whole leaf) into a large pot filled with water. Stew or spaghetti pots are good but not aluminium. Bring the water to a boil with the herbs in the water, place pot on a table, cover the head and pot with a towel, hang head over the pot, and breathe deep. Take sensible precautions to avoid burns from the pot and/or water and steam. When no steam is rising, reheat to boiling, and repeat treatment. When the herbs no longer have a scent in the steam, you can add more and continue the treatment until desired relief is achieved.

Tinctures: Tinctures are an alcohol-based extraction that is medicinally the most potent herbal treatment. When you dry herbs/botanicals the medicinal components are concentrated with the removal of the water. Soaking (tincturing) the dried herb/botanical in alcohol extracts those concentrated medicinal components and makes them available. An additional bonus is that alcohol-based tinctures are medicinally potent for years if stored in dark bottles or jars. We tincture most of our herbs and botanicals so they are immediately available for use, and we can be confident they are potent in an acute situation. We also keep dried herbs available for infant/child usage as teas, and also particular dried herbs available for poultices, and compress, and topical usage.

To prepare the tincture you need quart canning jars with lids, dried herbs/botanicals, and at least 90

proof vodka. Everclear is excellent to use. Also and in a pinch you could use another grain-based product. You want the alcohol to become saturated with the medicinal components of the herb/botanical, and other alcohol liquors/whiskey have components already saturating the alcohol so it probably won't be as medicinally potent, but it would still have more potency that other preparation methods. Fill the quart jar about 1/3 full of dried herb/botanical, chopped root, or crushed (not powdered) leaf, fill the jar to the "shoulder" with vodka/Everclear, secure the lid, shake, and put in a dark cool place. Every 2nd or 3rd day give it a shake. In 10-14 days, strain the liquid into dark bottles or jars, cap tightly, and label.

The commonly accepted tincture dosage is 1-2 eye droppers full, 1 dropper full equals approximately 1/2 teaspoon. Place half to one teaspoon of tincture in a glass of water and drink. Alternatively, you can use the dropper to place the tincture in gelatine capsules. You can also use tinctures to make a nasal spray for sinus congestion/infection. Buy some of those empty 1 oz (30 ml) nasal spray bottles at the drug store, put 8-10 DROPS of tincture in the bottle, fill the bottle with distilled water, and use as often as needed, 1-2 sprays per nostril.

Capsules: An easy reliable preparation is herbal/botanical capsules. You can buy empty gelatine capsules in health food stores by the capsule or by the bag of 1000. Just pop the capsule apart, fill the larger section with finely crushed (powdered) dried herb, put back together, and take with water.

Poultice: A poultice is warm, mashed, fresh, or finely crushed dried herb applied directly to the skin to relieve inflammation, bites, eruptions, boils, and abscesses. Depending on the size of the area to be treated, put enough herbs in a glass dish/pot, cover with enough olive oil, or water, or decoction of the same herb to thoroughly saturate the herb, heat gently until a comfortable temperature to the skin, apply directly to the area to be treated covering it completely, and then cover with a sterile bandage. Repeat the treatment as needed.

Bolus/Suppository: These are made using vegetable glycerine or cocoa butter mixed with a dried powdered herb to the consistency of bread dough. You may have to add some wheat flour to get this consistency. Shape the dough into a suppository shape and chill to set the form. When needed for use let warm a bit on the counter then insert appropriately. This method allows the herb to be in direct contact with the area needing treatment.

Syrup: To about a pint of decoction you add enough honey and/or eatable glycerine to thicken slightly. Licorice or wild cherry bark are commonly added as flavouring. Especially good for children to treat coughs, congestions, and sore throat as it will coat these areas slightly ,and keep the medicinal components in direct contact with the tissues.

C. Specific Herbs and Botanicals

We have tried to refine a list of herbs/botanicals, both wildcrafted and home grown, that would be most useful in treating the most common illnesses or diseases that may manifest in a survival situation. From the reading you have been doing in your newly acquired herb information books you now realize the

vast amount of information and herbs available for use. Just use this list as a starting point to adjust and personalize according to your needs and medical situations.

Wildcrafting:

The following 7 herbs and botanicals grow almost universally all over the U.S. and many more widely. Some are considered weeds.

1. Burdock (*Arctium lappa*): Harvest 1st year roots in the fall. Tincture or water infusion. Used internally Burdock will help with arthritis. Used as a poultice or compress Burdock will reduce swelling around joints. It has a blood cleanser effect (detoxifier) and is nutritive to the liver; also mildly diuretic.

2. Dandelion (*Taraxacum officinale*): Harvest 2nd year roots in the spring or fall; young leaves in the spring for fresh eating. Tincture, water infusion, syrup. Dandelion is a potent diuretic used internally as a tincture or water infusion. The root has been used for centuries to treat jaundice as it has a powerful alterative effect on the liver. Dandelion syrup is a good treatment for tonsillitis discomfort.

3. Echinacea (*Echinacea angustifolia*): Harvest 2nd and 3rd year roots in early winter after the plant has totally died back (see, you do need your map!). Echinacea purpurea: Harvest flower heads with seeds before petals drop in late summer. Tincture, water infusion, oil infusion, decoction, poultice, compress, bolus, syrup, capsule. Using these two varieties together gives increases the potency of your treatments. Used internally, Echinacea has been found to stimulate the immune response system. For strengthening the immune system, dosage suggested is a dropper full (1/2 tsp) daily for a 10-day course, no herb for 7 days, then repeat the 10-day course, etc. Used on this basis it is a flu and cold preventive.

It is also considered to have antiinflammatory and antimicrobial properties. This herb is a whole pharmacy within itself. An absolute must have in your survival stash. If you can only have one herb in your survival pharmacy make it Echinacea. One option now is to purchase 1# of cut and sifted Echinacea angustifolia root (currently $23/lb), tincture half of it right now, and save half for future decoctions and poultices. This will give you some time to gather your own root, and the tincture will be medicinally potent for at least 10 years.

Echinacea root tincture has activity against influenza, herpes, and other viruses which includes virus which cause the common colds. Echinacea decoction or tincture can be used effectively to treat gingivitis. Just soak a cotton ball or swab in the decoction and apply directly to the gums twice daily until the disease is resolved. Echinacea has a numbing effect on the tissues. There is anecdotal evidence Echinacea may be an effective treatment for athlete's foot, bladder infections, bursitis/tendinitis, Lyme disease, pneumonia, sinusitis, tonsillitis, viral infections, and yeast infections used both internally and externally.

4. Mullein (*Verbascum thapsus*): Harvest leaves before flowering, taking no more than 1/3 of the total. Tincture, decoction, water infusion, syrup. Mullein is an excellent treatment for respiratory complaints. It has expectorant action, soothes the throat, has bactericidal activity, and helps stop muscle spasms that

trigger coughs. Mullein provides excellent relief and protection against air-born allergens. It seems to give mucous membranes a protective coating that allergens cannot penetrate. A 1 tsp dose protects against allergy symptoms for 4-5 hours with no negative side effects. Mullein has been stated to have narcotic properties without being habit forming or poisonous. It is said to be a strong painkiller and helps to induce sleep. We have not experienced these effects using mullein.

5. Plantin (*Plantago major*): Harvest leaves before seeds form in early summer. Fresh, poultice, salve. Plantain is primarily a proven healer of injured skin cells, hence the topical usage.

A salve or compress of plantain applied appropriately is known to reduce hemorrhoid swelling and pain. Fresh leaf crushed and tubbed on insect bites relieves pain and swelling. The New England Journal of Medicine carried a study reporting that poultices made from plantain leaves can help control the itching of poison ivy exposures, it is good for poison oak also.

6. Red Clover (*Trifolium pratense*): Harvest flower heads in early summer. Tincture, water infusion, salve, syrup. Red clover tea or tincture taken daily is of great benefit in relieving symptoms of menopause as it is estrogenic. It is also of benefit in relieving menstrual cramps by taking daily during the menstrual time.

Red clover salve is real useful in treating burns. It is very useful for treating children because of its mild sedative effect and excellent for coughs, wheezing, and bronchitis.

7. Willow (*Salix*, any variety)

If you are allergic to aspirin do not use willow in any form as it contains salicin which is converted to salicylic acid

Harvest bark and twigs in the fall. Tincture, water infusion, decoction, compress, poultice, capsule.

If you are taking an aspirin a day for heart attack risk/angina prevention, switching to 1 tsp of willow bark made into 1 cup of tea daily provides the same protection. That tea dosage is equivalent to approximately an 81 mg aspirin. For larger dosage amounts, tincture is most useful keeping in mind the tincture will take about 1 hour to reduce pain. Placing drops of tincture directly on a corn, bunion, or wart daily for 5-7 days usually removes the corn, bunion, or wart. Pain relief lasts up to 7 or 8 hours.

Home-Grown/Cultivated Herbs and Botanicals

These next herbs are fairly easy to grow in a home garden as they usually do not grow in the wild. You need to start growing these plants now to have them established in case you really might need them.

1. Aloe (*Aloe vera*): Use fresh leaves as needed; cut a leaf close to the bottom of the plant, split it open, and use the gel inside topically on burns, minor cuts, and even radiation burns. Antibacterial, wound healing accelerator, antiinflammatory.

Most commonly found in a kitchen window in a pot, handy for instant use. You can buy potted aloe

plants at grocery stores, or nurseries, or get your neighbor to give you one. They live a long time and set new plants from shoots off the roots. You can separate these shoots from the roots of the mother plant and pot separately at 1-2" tall. They thrive best in light with well-drained soil, and do not require frequent watering.

2. Catnip (*Nepeta cataria*): Harvest whole flowering tops and leaves. Dry for water infusions, tincture.

An excellent muscle relaxer/muscle pain killer including menstrual cramps: outstanding treatment for colic, restlessness, and pain reliever for small children; commonly called nature's "Alka Seltzer" for its stomach settling properties.

Commonly grown from seed sown in the fall but can be grown from root divisions from a parent plant in the spring. Space roots/seeds about 2' apart as catnip can get quite large - up to 4'; does well in full or partial sun. We have never been able to germinate the seed, so purchase starts from the local nursery. The plant will self-seed if you leave some flowers on.

3. Comfrey (*Symphytum officinale*): Harvest leaves before flowering throughout the growing season. You can harvest 2-3 times from the same plant remembering to take no more than 1/3 the total leaves. Dry or use fresh for poultices, water infusions, oil infusion, salve, compress, and decoction.

Comfrey is right up there with Echinacea as a must have herb. Comfrey has a long history of use for treating sores, i.e. diabetic ulcers, indolent ulcers, and other wounds; contains a compound that promotes new cell growth. Apply comfrey as a compress, poultice, decoction soak/wash, or salve to sores or wounds daily until resolved; will also relieve swelling, and inflammation, and pain. Comfrey makes a wonderful water infusion that is extremely gentle yet powerful treatment for stomach, and bowel discomforts.

Comfrey is grown from root pieces. Just plant in the spring and stand back. It spreads via root extensions, needs moderate water, and partial sun.

4. Dill (*Any variety*): Harvest the leaves when the plant is established in the garden, about 1' tall, again, no more than 1/3 leaves per harvest; harvest seed when ripe usually mid summer depending on weather. Use fresh or dried as water infusion, tincture.

Dill is regularly used to dispel flatulence, increase mother's milk, and treat/prevent congestion of breasts during nursing. Drink as a water infusion several cups a day or take a dropperful of tincture daily.

Dill is easy to grow from seed inside or out; likes partial sun but warmth; will self-seed if you don't harvest all the flower heads for pickles and medicinal use.

5. Echinacea - If you cannot find enough Echinacea in the wild do grow it. It's easy to start from seed if you wait until air temperatures are 70 or above to plant. Does well in raised beds or regular flower beds; likes an alkaline soil, full sun, and moderate moisture. Refer to Wildcrafting section for preparations and uses.

6. Garlic (*Allium sativum*): Harvest bulb in late summer when the top has died back, cure (let air dry a few days outside) in the shade then store inside. Use fresh/cured bulbs or cloves of the bulb as water infusion, oil infusion, syrup, tincture.

Garlic is best known for it's antibiotic action, and for being a hypotensive agent (lowering blood pressure), and is effective in lowering cholesterol. It has been used medicinally almost 5000 years. Extracts made from the whole clove of garlic have consistently shown a broad-spectrum antibiotic range effective against both gram-negative, and gram-positive bacteria, and most major infectious bacteria in laboratory studies. How this translates into action inside the body is not entirely clear and needs more research.

Garlic taken internally as fresh in solid or as a juice may cause nausea and vomiting.

Garlic is easy to grow; just plant individual cloves about 1-2" deep, 6" apart in the fall for big bulbs or in the spring for medium sized.

7. Hawthorn (*Crategnus oxyacantha*): Harvest berries in the fall. Dry or tincture. Hawthorn has significant cardiac effects. It appears safe for long-term regular use, i.e. daily for years. It may be useful in congestive heart failure, arrhythmias, enlarged heart, and for symptomatic relief from cardiac symptoms.

Hawthorn is a tree; grows to 20-25' tall. We would suggest planting several if heart disease/problems run in your family. Be sure that the Hawthorn you are growing is the correct species for the medicinal properties.

8. Parsley (*Petroselinum sativum*): Harvest leaves throughout the growing season taking no more than 1/2 the total each time. In the fall cut the whole plant down to about an inch or 2 from the ground. Dry or use fresh. Tincture, water infusion, fresh and raw.

Do not use parsley during pregnancy as it can precipitate labour.

A supportive therapy in liver disease when jaundice is present. A mild water infusion is a good eye wash treatment for conjunctivitis and blepharitis. It is very good for urinary tract infections and as a diuretic. Has been used to dry up breast milk, which would be useful for weaning. A traditional breath freshener.

Parsley seed is notoriously a slow germinator sometimes taking 2-3 weeks to sprout. Plant barely 1/2" deep in lots of compost. After you cut back in the fall throw a cover over it, and in the spring remove the cover, water, and it likely will come back for another season.

9. Poppy (*Papavar somniferum*):

Be aware of the local legal status of poppies, and be aware that illegal possession of opiates has harsh penalties. Also note that there are a number of different poppies and most bought from the plant shop are not Papavar somniferum)

Harvest resin when the seed pod is fully formed, green, and juicy looking; harvest seed when the seed pod has dried, brown, and hard. Tincture, water infusion.

When the fully formed seed pod is fat, juicy looking, and still green, use a small sharp knife tip to make 3-4 shallow slits 2/3rds the way down the seed pod from the top to bottom direction, space the cuts evenly around the pod. The resin will slowly ooze out and begin to air harden, daily scrape off the semi hardened resin from the cuts and (wearing surgical gloves) shape the resin into a ball shape. Store in a glass container, cool and dark. Each day form the newly collected resin onto the ball. When the resin no longer oozes make 3-4 new cuts, spaced between the old ones evenly, and repeat the process. Three series of cuts per pod is sufficient. When the seed pod fully dries, and turns brown, and hard, and you can hear the seeds rattle when you gently shake the pod, pick the whole pod, and break open over wax paper or paper towel to harvest the seeds. Let a few pods remain on the stems and the plant will self-seed for the next year.

You can tincture the seeds or resin and also use the seeds for a severe pain relieving tea to use if the patient is conscious. A dropperful of the tincture might be used by inserting under the tongue of an unconscious patient.

Poppy seeds are usually planted outside when the ground is warm in the spring, partial to full sun, moderate water. Will self-seed if pods left intact on the stem.

10. Red Raspberry (*Rubys idaeus*): Harvest leaves throughout the growing season, taking no more than 1/3rd of the total until frost, then strip the canes. Dry. Most effective as a water infusion. This is a safe and useful herb in pregnancy. It may strengthen the uterine muscle, ease or prevent nausea, help prevent haemorrhage, reduce labour pain, helps reduce or prevent false labour, help decrease uterine swelling after delivery, and reduces post-partum bleeding. It also gives good relief of vomiting in sick children and is a good remedy for diarrhoea in infants.

Red Raspberry grows as 6-8 foot canes from spreading roots. Likes partial sun. Plant 1 year roots. Will produce for years.

11. St Johns Wort (*Hypercicum perforatum*): Harvest leaves before flowering. Dry, Tincture, water infusion. Grows wild in many places but most states list it as a noxious weed and spray it every chance they get. You don't want sprayed leaves. Best bet is to surreptitiously dig up a few sprouts and transplant onto your property.

St. John's Wort has many medicinal properties but is currently best known as a proven antidepressant with absolutely no side effects.

NOTE: St John Worts is a monoamine oxidase inhibitor so the same food restrictions apply to St Johns Wort as to pharmaceutical MAOIs – wine, cheese, and other foods. Exercise caution

We feel it may be extremely important to have an antidepressant available during a long-term survival situation, one you can safely take, and still keep functioning well on a mental and physical level.

A Couple of Additional Plants Worthy of Mention:

1. Foxglove (*Digitalis pupurea*)

Digitalis is a cardiac glycoside; it improves how the heart pumps when the cardiac muscle is failing, and it also slows the heart rate in a condition called atrial fibrillation which improves its efficiency. Foxglove has been used to treat these conditions for centuries; it has only been in the last 200 years that Digitalis was identified as the active ingredient.

Traditionally it was made into an infusion and drunk. An overdose of Foxglove can be fatal. Like any botanical medicine, in the absence of scientific testing of concentrations, there is degree of trial and error, however, you need to be aware of the potential fatal side effects of the trial and error. You must start with very low doses and work up to therapeutic dose/effect.

2. Tobacco

The active ingredient of tobacco is nicotine. Nicotine has a number of important pharmacological effects.

First, it is a muscle relaxant. This is from its direct effect on nicotinic receptors in the peripheral nervous system. It binds to the nicotinic receptors at the junction between the nerve and muscle and causes muscle relaxation. This is particularly useful in assisting the reduction of fractures and dislocations. If treatment has been delayed, muscle spasms associated with the injury may interfere with reduction. The spasm will both directly oppose efforts to adjust the position of the bone and contribute to the pain felt by the patient. In general, the administration of an analgesic and a muscle relaxant are indicated. Allowing a smoker to have a cigarette may help. In severe cases the use of a general anaesthetic is usually required. In the absence of other alternatives the following procedure may induce sufficient relaxation of the muscles to allow a successful reduction:

"A cigar is inserted into the rectum via the anus leaving at least a third of its length outside. If a cigar is not available, the tobacco is removed from 5-10 cigarettes and placed into a cloth bag, which is then inserted into the rectum so that an end which can be easily grasped remains outside. Sterile water is used as a lubricant, and, if a bag is used, the contents should also be thoroughly moistened prior to being inserted. After 5-15 minutes, the muscles should relax sufficiently to allow a successful reduction. The insert should, in any event, be removed after no more than 30 minutes. Note that nicotine is toxic. At the first indication that the patient is experiencing any difficulty, the insert should be removed by gently pulling on the exposed portion. Safety in using this technique relies on the relatively slow rate of transfer of nicotine from the tobacco leaves to the patient coupled with the ability to immediately halt absorption by removing the insert. It is therefore strongly suggested that no attempt be made to use an infusion prepared by "dissolving out" nicotine from tobacco. "

S Roberts. Personal Communication

Second, it can be used to control some intestinal parasites and worms. For an adult, tobacco equivalent to that in 1-1.5 regular cigarettes is ingested. This should result in passing at least some of the parasites within 24 hours. For particularly severe infestations the dose may be repeated no

sooner than 2 days after the original treatment provided a bowel movement has occurred in this period. Nicotine is toxic and some individuals are particularly susceptible to its effects; if the patient shows indications of susceptibility to nicotine poisoning, a second dose should not be administered. Its effectiveness in clearing parasites arises from the differences in sensitivity to nicotine between man and many common parasites. The primary problem with nicotine is the effect that produces the muscle relaxation also causes toxic effects, by activation of the nicotinic receptors in the nervous system.

A dose of 60 mg of nicotine will cause death in 50% of people who ingest it. The average cigarette contains 10mg of nicotine. While the amount of nicotine in cigarettes and cigars is relatively constant, there is large variation in concentration in both wild and cultivated tobacco. As a consequence there is a serious risk of overdose. Like with Foxglove, dosing is trial and error and using cultivated tobacco as a source of nicotine is potentially very risky and should avoided except in a major catastrophe.

Nicotine is also an effective insecticide and can be used as a spray on vegetables to prevent insect infestations.

3. Cannabis (*Cannabis sativa*)

This plant is deserving of special mention due to its widespread availability and use. Despite popular opinion, it has very limited medicinal uses. Small amounts taken infrequently produce relaxation, a degree of sedation, and appetite stimulation. It also suppresses nausea effectively. Several studies have demonstrated that for patients with chronic pain, nausea from cancer treatment, or muscle spasm small amounts may improve daily functioning.

However, larger amounts and chronic use do have significant medical consequences, and for patients with pre-existing mental illness, regular use can worsen symptoms. Cannabis may be of value in the same way that any pharmacologically active substance can be, but this is not an endorsement of its recreational use.

4. Honey

While not technically a plant, no discussion of botanical and herbal medicine would be complete without the mention of using honey as a healing agent. This is a common item in food storage programmes, but it needs to be in your medicinal storage preparations also. It is a very effective topical antimicrobial. It is easy to use but messy. It may also be beneficial in deep wounds and ulcers/bedsores.

Use: Pack the wound/ulcer with honey and cover with a sterile dressing. Change daily, cleansing the wound area with a strong solution of Echinacea root, repack with honey, then redress sterilely. Continue this treatment until the wound is healed. A real strong solution of Echinacea will have a numbing effect which will make the wound cleansing less painful.

This same treatment is excellent also for burns of varying severity. They will heal more quickly with improved skin regrowth. It may reduce scarring and infection.

Honey taken internally has also been found to be very effective in treating H. pylori which is the main culprit in the development of gastric ulcers. A tablespoon eaten every 1-2 hours for a week or so should clear up an acute condition, then a tablespoon 3 x daily for a week or so should clear up the condition entirely. A good maintenance dose would be a tablespoon daily.

5. Other medicinal plants

While there are many plants, which have medicinal properties, table 9.1 contains a list of some very common medications (not covered above) which are plant derived, and their uses.

Other common medicines and their plant origins

Plant Name	Medication Name	Clinical Uses
Erthroxylum Coca	Cocaine	Local anaesthetic
Atropa Belladonna (Deadly nightshade)	Atropine	Anti-Cholinergic – treats nerve agent exposure
Mucuna Species	L-Dopa	Anti-Parkinson's drug
Ephedra sinica	Ephedrine	Sympathomimetic / Decongestant
Pilocarpus jaborandi	Pilocarpine	Glaucoma therapy
Cinchona ledeenana	Quinine	Anti-malarial
Theobroma cacao	Theophylline	Asthma treatment
Chondodendron tomentosum	Tubocurarine	Muscle relaxant
Daphne genkina	Yuanhuacine	Induces abortion

Chapter 22: Primitive Medicine

Most of this book is about medicine when access to health care is delayed or unavailable in the short to medium term and you need to provide definitive care. Be it Third World countries, expeditions to the back of beyond, or an infra-structure destroying disaster. This chapter is for those that are thinking beyond this, what if your isolation is long term and permanent? What do you do? You well-stocked medical chest is running low! What do you do?

In this chapter, we discuss some of these scenarios, and what is possible, and what can be done, and some discussion around how. It is beyond the scope of this book to cover this material in detail and there is a degree of liability to publishing specific details; but all the information is freely available.

A brief examination of the medicine and surgery practiced by western Prisoners of War in both the Second World War and Korean War provide some good example of what is possible is a very low tech environment. Appendixes were removed, teeth extracted, and amputations performed. IV's were improvised and many low-tech medications were produced and used.

What becomes clear is that, with a little knowledge and improvisation skills, it is possible to maintain a surprisingly high level of medical care. Clearly, heart transplants and high-level intensive care would not be possible, but the quality of the medical care in a primitive situation can be surprisingly high.

This chapter is in three parts. First is a narrative around primitive medicine – knowledge, investigations, therapies and key principles when thinking about a long-term "grid-down" scenario from a medical perspective – heavy on philosophy as well as practical direction. The second section is a reproduction and critique of an article describing primitive medical care during the Korean War – while not 100% technically accurate, it contains a number of important ideas and provides an approach to thinking about primitive medicine.

Part 1: The Art of the Possible

a. Education/Knowledge:

Knowledge cannot be undervalued. While at first thought, it may appear that the loss of modern technology and medication will place medical care back in to the dark ages, it is important not to forget that the knowledge underpinning modern medicine is still there. While there may be no antibiotics for your dirty wound, you still have an understanding of what causes infection, basic hygiene measures, and good basic wound care, and while you may not have antibiotics to prevent or treat infection, you will still know how to minimise the chance of infection, and optimise healing, and hopefully a knowledge of other substances with antibacterial properties. The big advances in medicine in the last 200 years were discussed in the introduction chapter – many of these are possible in a primitive environment.

In a long-term disaster,it is vital that this knowledge is preserved. For this reason it is extremely important that you have a comprehensive medical library to begin with and that there is a priority to

preserve the knowledge the books contain. It is also very important that the knowledge is passed on. There is always the risk that you, as the medic, may die. Having several people with detailed medical knowledge initially is ideal but this for many may not be possible. It is important that there is a degree of cross-training within any group at least at a basic level. When it is apparent that a disaster is likely to be prolonged, it is vital that you begin to train someone to the same level as yourself; the best way is probably using an apprenticeship model over several years. This was the way the majority of western doctors (Middle Eastern cultures have had medical schools for the last 1500 years) were taught until the 17th century when the medical schools took over, and apprenticeships were still common up until early last century although they were considered inferior. Unfortunately, learning medicine simply from a book is inadequate, and having supervised experience in addition to books is the only real way to learn. For this reason if you are considering a long-term collapse, ensure that you also have the resources to teach the basics of biological sciences first before moving onto medicine proper. It would be difficult to teach someone the complexities of medicine without a good understanding of the basics.

The practice of medicine in the 18th and 19th Century provides, in our opinion, what we may realistically expect in terms of a technological level in medicine, but with our modern knowledge superimposed over the top. Look at how things were done then, and with what instruments, what medications were used, and how; what were the medical problems encountered? Much from that time is simply wrong and reflects the ignorance of physiology and pathology of the times but there is much to learn from history, and when approached with modern knowledge it is easy to identify what is useful information and what is not.

The ancient Egyptians had a useful system of classifying disease and injury which still works well where considering primitive medicine. They divided them into one of three groups:

- those conditions that can be treated
- those that can be contended with
- those that cannot be treated

It gives a framework to classify what you can do for your patients; those you can treat and cure, those that you can palliate or make comfortable (until they die or get better), and those that you can do nothing for or where your intervention is likely to make things worse. When it comes to a primitive situation, you need to convey a realistic expectation to your patients of what you will be able to achieve and this provides a simple framework.

What is also important is to understand three basic tenants of medicine – they are seldom explicitly taught but are vital to good medical care - listening, time, and reassurance. Listening to what the patient has to say, give them the time they need to communicate their concerns to you, and don't rush their assessment , and finally, don't under-estimate the value of your reassuring words – you may not know exactly what is going on but simple reassurance can go a long way.

b. Preventive Medicine:

A large proportion of the disease burden in the past was related to poor public health and preventive medicine. For the most part, it was related to ignorance of the role of bacteria in causing disease. Key elements of preventive medicine and infection control include:

- Clean drinking water – uncontaminated by sewage and waste water

- Hand washing – soap production is a priority. We are not talking a 10 second wash, we are talking a 1-2-minute wash with multiple rinse, lather and repeat. Clean between the fingers, clean the nails and clean the forearms; clean the entire circumference of each finger. Clean water and soap – it doesn't matter if the soap is medicated or not, the ability to produce a lather is what is required.
  This is the most fundamental thing to understand about modern medicine – asepsis – both in the prevention of disease within communities from a hygiene perspective, but also at an individual level with any patient contact or surgical procedure.

- Boil and filter water if purity not certain

- Sewage disposal – long drops or composting toilets and ensuring their drainage is not into the drinking water catchment

- Rubbish disposal – away from living areas, not draining into the drinking water catchment. Consider burying or burning what you can. Appropriate food waste into compost. You also need to consider how you will dispose of medical waste. Frequently this will be contaminated with blood and often infectious material. Incineration is probably the best option, followed by deep burial – away from water sources.

- Rodent and insect control – both are vectors for disease. Adequate rubbish disposal and trapping are probably the best methods for rodent control. Depending on climate, mosquitoes may be a problem; stagnant water and rotting soft wood are foci for the mosquito larvae.

- Hygienic food preparation and storage – a large amount of food poisoning is a direct consequence of poor food handling and storage. Hand washing before any food handling.

- Isolation of anyone with a potentially infectious disease. Although many illnesses are infectious before symptoms become apparent, it is important that any person who becomes unwell, particularly with fever or diarrhoea, is isolated immediately in an attempt to minimise further infections.

With diarrhoeal illness – simple hand washing is usually sufficient for the caregiver. With febrile illnesses or those with respiratory symptoms then barrier precautions should be used – gloves, gown, facemask (N95), and goggles should be used. If this level of protection is not possible then some form of face mask is needed when with the patient and hand-washing, changing clothes (hot wash), and showering before contact with the healthy.

For strangers arriving particularly during a pandemic, consider 10-14 days isolation followed by clothes burning and a through wash with soap before entering the community. There are no current infectious diseases with longer incubation times than 10-14 days. Provided the newcomer is symptom -free at the end of this period, you should be safe. This approach does not offer protection against those people who are carriers. However, among the current potential pandemic causes there are not currently carrier states although this needs to be considered.

The 2004 tsunami in southern Asia clearly demonstrates how quickly public health can break down. Despite widespread knowledge even in developing Third World countries about the basic principles of public health and hygiene, latrines have been dug next to water supplies, water wasn't being boiled, and in some places no effort was made to burn or dispose of rubbish and it was just allowed to accumulate. While it can be argued that some of this was due to "shell shock" from the disaster itself it just goes to show how the fundamentals can go out the window in a stressful situation.

c. Assessment:

As we have previously discussed, assessment of a patient has 3 components – history taking, clinical examination, and investigations. At present in medicine, there is a heavy reliance on investigations; in a long-term austere situation, history and examination will come into their own again.

i. History Taking and Examination:

With very limited access to investigations, the importance of clinical examination will again take on enormous importance. While modern doctors are competent at physical examination, there is heavy reliance on special tests, and many of the skills of accurate physical examination have faded. The basics are easily learned from any clinical skills textbook with a little practice. We recommend Talley and O'Connor, Physical Examination). With more exposure and experience, you will be able to elicit more information. It is almost certain that, in long-term austere situations, that physical examination will come into its own again. The history, 95% of the time, is all that is required to know exactly what is going on. The examination and investigations may be used to confirm your thoughts, but it's the history that usually gives you the diagnosis.

ii. Investigations:

Laboratory tests: Lab tests which are possible in an austere environment are discussed in the Laboratory chapter. These include basic urine analysis, blood typing, and cross matching, and simple cell counts. The minimum requirement is a microscope and slides. It is important to note that well cared for microscopes will last 100's of years.

X-rays: These will not be available in the austere situation. One of the main uses of simple x-rays is in the diagnosis of fractures. There are several low-tech ways that are reasonably accurate in diagnosing fractures.

Fractures of the long bones (tibia, fibula, femur, humerus, clavicle, ribs, etc), can be diagnosed by either percussion, or a tuning fork, and a stethoscope. Using a tuning fork is more accurate. A bony prominence on one end of the bone in question is tapped, or the base of a vibrating tunning fork is placed against it, and the stethoscope is applied to the other end. This is done bilaterally and the two sides compared. If a fracture exists on one side and not the other, the gap in the bone at the fracture site will result in less sound being transmitted so the sound will be somewhat muted on the side of the fracture. Some specific points and caveats should be noted:

Sound waves will cross joints. For percussion, finger or toenails can be tapped. To diagnose a hip fracture, the sound source is applied to the patella (knee cap) and the stethoscope applied over the pubic symphysis.
The technique is less effective on the obese as fatty tissue will absorb sound waves.
Bi-lateral fractures can result in false negatives.

A 128 MHz tuning fork should be used as frequencies above this will tend to jump fracture gaps.

For long bones running near the surface of the body a fracture can be localized by drawing the tuning fork along the bone slowly (>30 sec, but <60 sec) until a very localized source of pain is identified (<3 cm).

Compacted bone ends of a fracture can result in false negatives.

A cone formed from rolled paper can act as a substitute for a stethoscope but is less than ideal.

Once again, the reality will be that the most useful method for diagnosing fractures will be clinical examination. This is also the case for the clinical chest examination in patients who would previously have had a chest x-ray.

d. Treatment

The trick to learn for patient care in a truly austere and primitive situation is to do what you can do, extremely well. You may not have access to many medications or much equipment, but do what you are able to do well and you will save lives. Basic hygiene and basic nursing care don't require much to be done well. The classic survival cliché is a simple scratch could result in you dying from gangrene infection of the leg. While at the extreme end of the spectrum this may be true, cleaning the wound with copious amounts of water and keeping it covered will prevent most infections; if there are signs of infection further good basic wound care, resting the limb, and keeping it elevated for 48-72 hours will further lessen the chances of serious infection all without antibiotics. Now obviously, sometimes antibiotics will be lifesaving but you can reduce the reliance on high-tech treatment by doing low-tech treatments well.

i. Medical Supplies/Instruments

Bandages and Dressings: Any absorbent material may be used as a dressing and any length of material for a bandage. It would be wise to identify what you plan to use in advance and ensure you store it. Wool, when washed free of lanolin, is very absorbent and is one possibility. Trousers can be cut along their length can provide a bangage of decent length.

The primary problem with dressings will be with sterility. Provided the material used for dressings is clean, in most cases this will have very little impact on the incidence of infection. If you require a higher degree of sterility, boiling your dressing material and then air-drying prior to use is an option – not perfect, but this will give you a degree of sterility.

Syringes and needles: Plastic syringes and needles are readily available and relatively cheap. If possible you should purchase as many of these as possible. While designed to be disposable, plastic syringes can be reused; they should be thoroughly cleaned and resterilised by boiling. It may be possible to do this several times before the rubber and plastic degrade. Before sterilizing syringes that you are reusing, soak them in a solution of dishwashing detergent or soapy water.

Needles, again, can potentially be reused but it can be difficult; all blood and tissue debris needs to be removed from the inside of the needle using a fine piece of wire from the top down, they may need to be straighten at the end, and the tip resharpened. They can be resterilised by autoclaving, boiling, or soaking in bleach.

It is important to realise that the above advice is for extreme emergencies only. and it may be difficult to completely resterilise needles and syringes, and this leaves a risk of transmission of viral diseases.
The ability to manufacture syringes and needles is likely to be severely limited. It will certainly be possible to manufacture syringes if you have access to a glass blower – they are technically not difficult to make at least in a crude form. Needles, unfortunately, are potentially a different story. Even a good blacksmith will have great difficulty manufacturing fine needles. It may be possible to manufacture larger needles and cannula but they too are likely to be very crude. Alternatives to consider include bird quills and those made from blown glass.

The ideal situation is to try and obtain glass syringes and old-fashioned needles which can be reused and resharpened. They are surprisingly easily available from antique shops, auctions, and eBay.

Surgical Instruments: When buying surgical instruments, it is tempting to purchase the cheapest you can find. This approach is fine if you are anticipating only using them half a dozen times. After that, the scissors will lose their edge and be impossible to sharpen, the needle holders will begin to let the needles twist, and the forceps ratchets keep slipping. Unfortunately, as with most things you get what you pay for. If you are preparing for a long-term scenario then you need to invest in good quality equipment, otherwise, they won't last the distance. Good quality instruments will last longer than you will. The top quality equipment is designed to be reused in a hospital several thousand times and still work well – this is more often than you will use them in a hundred years!

The other option is the manufacturing of your own instruments. A good metal worker will be able to create instruments to a high standard but it very unlikely that they will ever match good quality pre-crash instruments. This also assumes that you will have access to a craftsman and a forge, but it is potentially an option.

Many instruments can be improvised. Scalpel blades can be manufactured from thin pieces of steel – provided they can be sharpened to hold an edge. Dental extraction forceps can be improvised from pliers. Many automotive tools are very similar to some medical instruments, and provided they are cleaned and sterilised, may function well.

Suture material and needles: Most suture (particularly the non-absorbable) material will keep for a very long time. So, again, the ideal situation is to stock up in advance or scavenge. Alternatives to commercial sutures are discussed in the Wound Closure section. As with instruments, it is likely a competent metal worker will be able to produce a reasonable range of suture needles.

"Gut" was the original surgical suture material. It is not exactly gut, it is the muscular layer stripped from the wall of the small bowel of sheep's intestines and preserved in alcohol. Cotton thread can be used both for skin suturing and internal sutures (even though it is not absorbable it can be left in place). It can be sterilized by wrapping it around a 1cm/0.5in rubber tubing and immersing in boiling water for 20 minutes, and used while it is still wet. Make sure the thread you use has a breaking strength of more than 1.5 kg/3 lbs by hanging an appropriate weight from a 10 cm/4 in long strand. If it doesn't bear the weight, double or triple strands can be used. Avoid using this for interrupted sutures where possible.

Other equipment and supplies:

The trick with improvising medical equipment is ingenuity. Always look at what you have and think, "what else can I do with this?" For example, urethral catheters can be used as a catheter, or as a chest drain, or to control a severely bleeding nose, or as a cannula in an IV cut-down; a safety pin can pin bandages, open an airway by pinning the tongue to the lips, close a wound, remove a foreign body, or pop an abscess. Many items of medical equipment have multiple uses. Some are a poor second choice to proper equipment, others do a first class job; the key is think broadly about possible uses.

It is also important to realise that you have a huge scope for do-it-yourself equipment. Below is a list of just a couple of ideas for improvised equipment but it's just a starting point, there is vast potential:
Splints – For a fracture to heal it needs to be immobile, and comfortable, and not cause pressure points. Plaster of Paris and fibreglass have been used for most long-term splinting for the last decades. Splints can be manufactured from just about anything that can immobilise a fracture site. Wood, plastic, strips of material, spun wool, all in various combinations can be used to construct an adequate splint for a limb. One author has previously manufactured a perfectly workable traction splint for a broken femur from fencing wire, duck-tape, and some insulation foam.

Fly Trap – Flies are a major vector for disease transmission particularly of diarrhoeal disease. The key factor in reducing the number of flies is adequate waste disposal. But trapping can also have a significant impact on numbers. Simple flytraps can be made with plastic soda bottles (of which there will be thousands around for years to come, regardless of what disasters may befall us – given their slow decomposition).

Asthma spacer – Moderate to severe asthma attacks are frequently treated with oxygen-driven nebulisers which aerosolise the asthma medication and improve delivery of it to the lungs. Over the last few years, volumetric spacers have started to replace nebulisers. These are small plastic cylinders with a mouth piece which the patient breathes in and out through. The medicine is sprayed into the chamber of the cylinder and the patient breathes it in. The concept is that if medication is delivered into a confined space it doesn't disperse so quickly, so by having the patient breath in and out through the spacer, more of the medicine is delivered to the lung. A perfectible useable spacer can be made from a 2l plastic soft drink bottle; the patient breaths in and out through the mouth of the bottle, vent holes are cut in the base, and a hole cut on the side for the inhaler to spray through.

ii. Medications

Modern medications: While these will eventually run out, it is important to realise, as is discussed elsewhere, that the expiry dates on many medications have little relationship to how long they are safe

and effective. The following information is for entertainment purposes only, and we do not recommend relying on this information except in a life-threatening emergency.

As has been outlined earlier medicines tend to lose their effectiveness in treating a condition rather than becoming dangerous. Expiry dates simply reflect the longest period the drug companies are prepared to admit they have studied stability for. Several companies (probably most – but they don't own up to having the data) have stability data extending 5 or 10 years beyond the expiry date on the packet. It has been cynically said that expiry dates are more about marketing, turnover, and profits than about patient safety.

Common medications that appear to have prolonged (up to 2-10 yrs), safe, and effective usage beyond their expiry date based on FDA and US military work include:

- Penicillin-based antibiotics
- Ciprofloxacin
- Phenytoin
- Atropine
- Pralidoxime (2PAM)
- Diazepam
- Cimetidine
- Opiates
- Thiopentone
- Paracetamol (Acetaminophen)
- Normal saline
- Lactated Ringer's

1. Synthesis of drugs

There are some several common and important medications that are relatively easily synthesised, and many others for which low tech synthesis is theoretically possible, but technically very challenging, and labour and time consuming. The requirements, aside from knowledge and time, are access to basic high school level laboratory equipment (there is also plenty of room to substitute things such as Pyrex kitchen bowls, measuring cups and kitchen scales), and some chemical reagents – which may need to be made themselves - the need to produce chemicals to produce other chemicals. It is likely that only a larger community could spare the resources to sustain a meaningful manufacturing system. We believe that community specialisation is likely to occur, and that medicine production (and medical supplies), and the provision of medical services may well be a desirable area of specialisation. The quality of the drugs produced will be significantly lower than current pharmaceutical standards; it becomes a risk/benefit situation in terms of using them.

However, safe, useable drugs can be manufactured. Like other areas of preparedness this requires advanced thought and preparation about what you consider you may wish to manufacture.

A. Simple Manufacture:

Alcohol: Production of alcohol is very straightforward; we have been doing it for centuries. The problem is producing ethyl alcohol and not one of the many toxic alcohols particularly methyl alcohol which can

easily occur. The basic process is well-covered in many books, and on the Internet, and is not difficult. It is useful for its antiseptic properties and also in the production of ether. While pure ethanol is toxic to internal tissues at concentration, it is fine for cleaning intact skin and disinfecting surfaces.

Ether: One of the major advances in medicine in the 19th century was development of anaesthesia which gave the ability to perform painless surgery. Anaesthesia in the hands of an untrained person will have a very high death rate, but, in an austere situation, potentially could be lifesaving. The first two anaesthetic agents were chloroform and ether and both are relatively easily produced. Ether is probably a safer agent and slightly easier to manufacture. Anaesthetic ether is diethyl ether – not to be confused with other varieties of ether.

The best way to produce ether is by dehydration of ethyl alcohol with sulphuric acid. When ethanol is mixed with sulphuric acid and heated in a glass distillation chamber (as found in any high school chemistry labs) it produces ether vapour which condenses to liquid. It must be maintained within a certain temperature range for the reaction to occur. The process is essentially a continuous one with repeated addition of further alcohol. It is vital that the alcohol added to this reaction is ethyl (i.e. drinking) alcohol – other sorts will not produce diethyl ether and will be very dangerous. The sulphuric acid is reusable and catalyses the process.
Sulphuric acid is widely available, most commonly in lead acid batteries, and should be relatively easy to scavenge. During the Second World War, Australian Prisoners of war in Indonesia produced ether with acid stolen from car batteries and home brewed alcohol. It can be manufactured by burning sulphur and saltpetre (potassium nitrite) together and, while not complicated from a chemical point of view, it may be difficult practically although this process has been producing sulphuric acid for 400-500 years in very austere circumstances by modern standards. Of note is that mixing saltpetre, sulphur, and charcoal produces gunpowder.

The above description is only to provide the most basic of overviews and anyone considering producing ether should be consulting a reputable organic chemistry text. These substances are highly volatile, and the risk of explosion is very real. Also be aware that diethyl ether is a key ingredient of amphetamine production and as such may be illegal in some jurisdictions, and you may bring undesirable attention on yourself. It is also worth noting that chloroform is also relatively easy to syntheses.

Charcoal: Charcoal has a variety of medical uses the treatment of diarrhoea being the most common. The charcoal used in the treatment of poisoning (activated charcoal) is very different to standard charcoal, and while standard charcoal will absorb substances from the gut, it is not very efficient. Charcoal is also extremely useful to burn in forges to generate the extra heat required to smelt metals, and in the production of black powder, and sulphuric acid discussed above. There are several methods for production which won't be discussed in detail here but essentially it is formed by the combustion of wood in a relatively oxygen-starved environment.

Normal Saline: Normal saline is perhaps the most versatile of the intravenous fluids. It is extremely easy to manufacture. Standard normal saline consists of 1000 ml of distilled water with 9 grams of sodium chloride producing a 0.9% saline solution. The process needs to be sterile which may be difficult to achieve in a survival situation. The basic principle is the same as canning, and information on this is widely available. In view of the borderline sterility of production, the finished product should be used within several days of production preferably within 24 hours.

Bleach: Bleach (a concentrated chlorine solution) is an excellent disinfectant of water, surfaces, and medical instruments. It is relatively easy to produce. It requires a low voltage power source (12V car battery is fine), a conductor made of carbon (or charcoal), a supply of water, and a small amount of table salt. The positive electrode is connected to the charcoal and the negative wire (with the plastic covering removed) is placed in the solution. The current is applied and chlorine is produced. Details of the exact method can be found at http://www.pqs.org/ingl.htm

B. Complex Manufacture:

It is not possible to discuss the manufacture of these drugs in detail and below we just provide a superficial overview, but it is included to provide some reassurance that limited complex drug production is possible.

Antibiotics: Production of sulphur-based antibiotics, penicillin, and chloramphenicol in a primitive situation is potentially possible. However, the manufacturing processes are very labour intensive, require a long-term commitment from several people (potentially taking labour away from more important survival tasks), some basic laboratory equipment, basic chemicals, and an understanding of simple laboratory procedures.

Sulfa antibiotics: These were the first antibiotics developed in the late 30s. They tend to slow bacterial growth rather than killing the bacteria outright so aren't as effective as those antibiotics that do kill bacteria. They can be life-saving in severe infection slowing bacterial growth enough for the body's immune system to catch up. Their manufacture is relatively straightforward. The production of Sulphanilamide, the first sulfa antibiotic is a relatively common college-level organic chemistry experiment.

Penicillin: In the case of penicillin the ideal situation would be to have a pure culture of the penicillase fungi prior to any emergency situation but this clearly has logistic implications. It is possible to isolate the penicillin- producing fungi from mold growth but this adds another complicated step. The main problem is that a single culture will only produce 100,000-200,000 units of penicillin and this is about a third of a single dose. Multiple cultures will be required. Again, the key point is that low-tech production is possible but probably not viable for most communities.

Chloramphenicol: This was originally grown from Streptomyces venezuela. It, however, can also be synthesised from Acetophenone in a relatively complicated transformation reaction. However, with access to laboratory equipment and the right reagents, its production is not difficult.

Insulin: Unfortunately, there are a large number of people who suffer from diabetes and require insulin to control their blood sugar. There are two sorts of diabetics – Type I or insulin-dependent diabetics and Type II or non-insulin-dependent diabetics. Type I diabetics require insulin to survive. A small number of Type II diabetics also require insulin to have good control of their sugars but survival in the medium term may be possible without it, using diet control and exercise.

Like the production of penicillin, the production of insulin requires a lot of time and labour, access to quality laboratory equipment, and an ongoing supply of pig or sheep pancreas (perhaps several animals a week depending on the production yield). It is basic chemistry, and like penicillin production, is not challenging to anyone with knowledge of basic chemistry, but, again, the challenge is gaining access to

the required equipment. What you produce will not be anything like pharmaceutical grade and will be much more immunogenic than current commercial insulin but it will potentially keep insulin-dependent diabetics alive in the medium term.

The basic procedure is straightforward: extraction with 70% alcohol buffered to a pH of 1-2 with HCl to prevent digestion of the insulin by other enzymes from the pancreas followed by a five or six step fractional precipitation/crystallisation process to get useable insulin. In reality any concentrated acid is potentially suitable. The process of crystallisation is aided by the presence of zinc.

Insulin can be extracted from many animals. Porcine (pig) insulin is probably the closest chemically to human insulin which is likely to be readily available. Sheep or cows are also a possibility, but the insulin is chemically more different to humans and, hence, more likely to cause allergic reactions.

A bovine pancreas yields about 75 mg/kg of insulin which assays at 26-28 IU/mg after purification, porcine pancreas a bit less, sheep yield only about 800 IU/kg but may be available in areas where other animals do not thrive. We have deliberately avoided detailing the actual process as this information is freely available in medical and science libraries, but in view of the complex nature of its production, the details are of minimal relevance to 99% of readers.

Thyroxine: Synthetic Thyroxine is a medication required by some people with under-active or surgically removed thyroid glands. In contrast to insulin this can be administered off-the-hoof. Because there is less breakdown of thyroxine in the stomach, oral administration is possible. Currently the need for and monitoring of patients on thyroxine is done using blood tests. In an austere situation the diagnosis would have to be made purely on clinical grounds which may be difficult. However, for those already diagnosed and on Thyroxine, it is possible to treat them with sheep thyroid glands – several times per week – using resting basal body temperature as the baseline for treatment. Taking the temperature first thing in the morning before getting out of bed will show the subtle falls and rises in temperature associated with too much or to little thyroxine providing an indication of when to give and when to withhold the sheep gland. Again, this system is not perfect but it provides a possible solution for someone chronically taking Thyroxine.

As can be seen from the above examples relatively complex drug production is possible in austere conditions. However, nothing is ever easy – other chemicals are required for the process which may be just as difficult to obtain or manufacture, and certain items of laboratory equipment may be needed that are hard to improvise but it is possible. None of the above reactions are any more complicated or sophisticated than the manufacture of methamphetamine and amateur chemists in big cities and rural areas all over the world are cooking this! The above medications can be manufactured with 16th or 17th Century levels of technology with relative ease, and simply with 18th Century levels – it will all depend on how far back we descend.

C. Plants:

In a sustained long-term disaster medications derived from plants and the limited range which can be easily synthesized will essentially be the only medications available. Traditionally, plants have been our main source of medicines and in the event of a long-term event they will be again. Botanical medicine is covered in more details in Chapter 21.

It is important to be aware of which plant-based medications have clearly proven clinical efficacy and which only have anecdotal effectiveness. It is a current problem with botanical medicine that only a minority of therapies have proven benefit. That is not to say that many more are not very effective but only that there is no evidence for their use aside from anecdotes and case reports, but in a long-term situation using plant-based medications with limited evidence (combined with a placebo effect) may be the only option. You may need to adopt the old traditional approach of trial and error in determining effectiveness and dose.

You should attempt to get a guidebook to medicinal plants relevant to the area you are living in, there are numerous guidebooks around for different areas, and they contain some very valuable local information.

iii. Surgical Therapies:

Surgical principles are relatively simple as well and are discussed in more detail in the Surgical Chapter 10, but there are some broad principals which can be carried over into a primitive environment – like many things discussed in this chapter, basic principles will substantially improve survival for the patient.

1. Try and maintain antisepsis.
2. Handle tissues gently / remove dead tissue.
3. Control haemorrhage as you go with a procedure.
4. Local anaesthesia, sedation or general anaesthesia to minimise physiological impact of the operation.
5. Always drain pus - The medical truism has been "never let the sun set on un-drained pus". The basic principle described is that an accumulation of pus is a bad thing and letting it out as soon as possible is a good thing.

You can teach yourself basic surgical skills and techniques on recently dead animals – for 30-60 minutes after death the tissues will behave in a very similar way to living tissue.

Like surgery, the principles of orthopaedics (bones and joints) are remarkable straight forward. At times, the practical realities are more complex, but the basic underlying principles are simple. Bones are fantastic at healing themselves – to do it optimally they need to be straight, pulled out to length, and immobilised, and the patient needs to be well fed and able to rest the affected limb.

1. If a joint is dislocated, reduce it back to its proper position as soon as possible – there are specific techniques for individual joints not described in this book. A good reference is “McKae’s Practical Orthopaedics”
2. If a bone is broken and is bent or deformed, return it to its normal anatomical position as soon as possible and splint it straight.
3. If a long bone is broken and the limb is shortened traction the limb to its proper length and maintain the traction or splint it at length.
4. Bones heal in 4-8 weeks.
5. If the bone is visible through the skin, (a compound fracture), the exposed ends need to be washed with litres and litres (literally 10s of litres) of sterile water prior to straightening and tractioning the bone. Once reduced, the wound needs further extensive irrigation. They should also receive a broad spectrum antibiotic if available. Ultimately, compound fractures can become

infected despite the above and potentially this will require amputation – the only austere options to minimise this is massive irrigation.

iv. Physiotherapy/Occupational Therapy:

These therapies support medical and nursing care and are very important. Physical therapy focuses on maintaining and rehabilitating musculoskeletal function – stretching, massage, and muscle-strengthening exercises.

Occupational therapy is focused on rehabilitating people to perform the activities required to look after themselves – eating, dressing, and personal hygiene.

It is beyond the scope of this book to discuss either in detail – but if your goal is to rehabilitate a seriously injured or ill person back to full function within your community, this aspect of care cannot be underestimated. Most communities will not be able to carry many people who cannot contribute meaningfully to the group. The goal of physical and occupation therapy is to maximise a patient's physical functioning, and get them to a point where they can look after themselves and contribute. If you have a group member who has suffered a serious injury or illness early on, you should focus on what they are likely to be able to do and tailor their rehabilitation to being able to perform that role.

You also need to decide as a group how many people you can support who cannot contribute to the group and who may require significant care and resources to survive with no return. You may face some difficult decisions. Fortunately with therapy most people are able to perform some meaningful work to "earn their keep".

The only book we have found specifically aimed at Physical and Occupational therapy in an austere environment is "Disabled Village Children" by David Werner author of "Where There Is No Doctor" which is available as a hardcopy or online. (http://healthwrights.org/books/disabledvch.htm). The book is primarily focused on the rehabilitation of patients with childhood disabilities and diseases but has much to offer regarding the rehabilitation of anyone who has suffered serious illness or injury and the focus is on practice in Third World environment which translates well to an austere or survival situation.

Part 2: 'Primitive Medicine' from Combat and Survival Medicine.

We believe this section originally formed part of the course notes from USAF Survival training school manual or an early version of the Special Forces Medical Handbook and contains notes on patient management in North Korean Prisoner of War Camps during the Korean War. It has also been published in various forms in several other publications and widely on the Internet. We have been unable to identify a copyright holder.

We have reproduced it here because we believe it adds an extra dimension to the consideration of what is primitive survival medicine and the issues that need to be considered and it is an interesting read.

The methods described here show what can be done in a truly primitive environment – these described techniques work. They are a long way from being the best treatment – some of them have elements of risk to them – but they show the innovation possible when your options are limited.
There are similar articles describing innovative primitive medicine from the Japanese prisoner of war camps in the Second World War:

1. "A Unique Surgical Experience in a WWII Prisoner of War Camp". Des Poidevin. ADF Health Vol 6 Apr 2006
2. "The War Diaries of Weary Dunlop". Sir Edward Dunlop. Penguin Publishing, Oct 2010.

"Primitive Medicine" by Dr. Gene N. Lam

I. OBJECTIVE*: To provide the shortest possible course on Primitive Medicine in a Survival Situation.*

II. INTRODUCTION*: This article is based on Dr. Lam's personal experiences and first-hand observations in Korea. Major Gene Lam, United States Army doctor, is very often quoted in survival training school lectures.*

You may not remember the greater portion of this article half an hour after you read it, but, if you are on the ground behind enemy lines or even in a desolate area of friendly territory, some of this will come back to you. If it helps save the life of even one man, then this article will have been well worth the effort on our part to reproduce it for dissemination to the air crews assigned to this unit.

"You must learn basic first aid" - what to do for fractures, cuts, burns, etc. If you go down, you are supposed to have all kinds of things with you - a survival kit, a first aid kit, and print instructions about using them. Let's assume however, that you land with only the clothes on your back - it happened just that way to lots of men in Korea. You must know how to get along with what you have; to make do.

God gave you two important things - your head and your hands. If you think and intelligently use what you have, you can take care of yourself.

That's why I believe everyone should be taught to survive under the worst possible circumstances. Then if he is in a less strenuous situation, he can get along well; if he has aids for survival, they're so much gravy.

III. SURVIVAL FIRST AID: *When you learn first aid and study survival medicine, you must assume that there will be no one but you to practice it. In survival and evasion there probably will not be anyone else except perhaps men from your own crew. All six doctors captured with me were put in one PW camp, but few USAF doctors are apt to be captured and you may be in a camp of only Air Force prisoners. You may not have a trained medical corpsman - you should not expect to have one.*

When most of these observations were made, there were five doctors in the camp with me. Thanks to all of them - including three who later died - I can tell u these things, not as my own isolated findings, but as our group opinion.

Immunization helps, don't avoid shots. You can save your life by keeping your immunization record up to date. No man died in Korea of any disease for which the armed services gave immunization shots.

IV. NOT ADVANCED SCIENCE - BASIC PRINCIPLES: *All of us - patients and doctors alike - depend today upon the wonder drugs, fine laboratories, modern medical equipment. We have too easily lost sight of the "country doctor" type of medicine, of the things men always have that can save them - determination, common sense, and a few primitive techniques. Some of these remedies were practiced by the Greeks, Romans, and Arabs long before the birth of Christ. They are still good today when no other means are available. It's amazing but man can and does live without penicillin for every ache and pain.*

V. REGARDLESS OF WHAT IT IS - EAT IT*: One basic principle of survival medicine is to eat. After you have been down a few hours, you get hungry. If you can, find something edible and eat it. If you are captured, someone soon will bring in a bucket of slop and, after your stomach has flipped from the sight and the smell of it, you may say: "I can't (or won't) eat that stuff."*

You better eat it because that's all you'll get and it may get progressively fouler and skimpier. Here "will" comes in. Say to yourself, " I'll eat everything they give me and the nourishment will help me to get through." You must eat everything you can get - issued rations, things you can steal, things you procure from the environment.

We ate dogs, cats, rats, weeds, maggots. For a while we got only field corn, boiled for half an hour. It is tasteless, but it will keep you alive. In fact, we were living it up when we got that corn mash.
Most PW's in Korea ate dog but it was hard to do. Dogs are a delicacy in that area and we weren't issued luxury items, but once in a while a stray could be shanghaied. The town we were in has a stray cat. Pussy didn't wander long. It was quite delicious, rather like squirrel.

It helps not to be able to identify a strange dish the first time it's served, but after the first time, the ingredients don't really bother.

It was difficult to down rats but they were edible. I strongly recommend cooking them because raw they can carry several diseases.

Snakes, of course, are eaten the world over and some varieties are delicious. Just chop off the head, skin the rest, cook, then eat what's left. Even poisonous varieties are edible.

Maggots are something else. Once we were issued rotten fish loaded with maggots. Our English cook protested and wanted to scrape them off. Afraid that some of the fish would be lost, I insisted that he cook fish, maggots and all. We ate the results, which were quite good.

In May 1951, every PW in camp was swollen like a balloon from severe beriberi. Since spring weeds were beginning to appear, we figured we could boil them as a cure but there wasn't a weed in camp. However, some of us were taken almost daily to a river for wood and other supplies. The criterion for success soon became not how much wood but how many weeds we could bring back. We didn't know what kinds of weeds they were, but we picked them, boiled them and ate them. Our beriberi disappeared.

You will be revolted by food given you as a PW, but if you miss one meal as a prisoner, it will take you weeks to regain your lost strength. You can't afford to miss a single bite when you are on a bare subsistence diet. If you're going to live, eat. If you plan to escape, you must have strength to do it.

***VI. YOUR RETURN TICKET - YOUR OWN FEET**: Your two feet are the the other half of the round-trip ticket. The importance of caring for your feet cannot be over emphasized. Men walked barefoot for miles over snow and ice when the Korean weather was 45 to 50 degrees below zero. Those who took proper precautions got neither trench feet nor frozen feet.*

The precautions are simple. If you have shoes and socks, periodically take them off and rub your feet for five or ten minutes. You won't get frostbite.

If you have two pairs of socks, put one pair next to your skin and keep it dry. Change to the dry pair at least once a day. When you bed down at night, take your shoes off. Any man who gets frostbite is guilty of neglect amounting to misconduct.

In order to land safely after the bailout, to walk and protect your feet, you must have proper boots. Those men who landed in North Korea with low cuts will back me up on this.

Incidentally, if you remove the steel arch support that is in most boots, and sharpen it on a rock, you will have an excellent surgical knife.

***VII. DYSENTERY**: Dysentery becomes a problem in enemy territory to most men - be they evaders or prisoners of war. The risk of dysentery can be greatly lessened if you have and properly use halazone tablets or iodine, or if you boil water. But there will be times when you cannot possibly take such precautions. Also, men have gotten dysentery from nothing more than just being scared.*

What is dysentery? In our camp we set up an arbitrary standard: 25 stools per day. Eight to ten was normal and 15 was simple diarrhea.

What can you do about dysentery? You will lose much water you must replace. If possible, replace it with boiled water, but at any cost drink quantities of liquids. You must also eat, even if that means choking down food.

Charcoal can help. Take any partially burned piece of wood, scrape off the charred portions and swallow them. How much? Oh, about a handful.

Bones - any kind of bones - can help. They are best if burned and ground into ash, but you can grind bones between rocks to a powder. Just swallow the powder.

The communists, anxious to "educate" every prisoner of war, usually have lots of chalk around for writing on the "wonders" of Bolshevism. Steal some ordinary schoolroom chalk, powder it and swallow it. It too, will help cure dysentery.

Pull bark from trees, preferably oak trees, but any kind will do. Boil it from twelve hours to three days. As the water evaporates, add more. The resulting brew will be so black, so vile tasting and so evil smelling, that it will choke you.

But boiled bark contains tannic acid and that will help to cure your dysentery. It also can help further the healing of burns. Boiled bark is so terrible to choke down that we were never really sure whether people willed their dysentery to quit rather than swallow the medicine. (I remembered this remedy because my grandfather had used tree bark to cure deer hides and I figured that something with enough tannic acid to cure hides probably contained enough to cure dysentery.)

Tea is another dysentery cure because it, too, contains tannic acid. Men who'd had chronic dysentery for two or three years were cured when we got enough tea. Strong tea solutions which contain tannic acid in concentration have also been used for centuries for burns.

***VII. HEPATITIS**: In the summer of 1951, when the Communists talked mildly about bacteriological warfare, we laughed it off as impossible. We still joked about it when they inoculated us against this ridiculous "threat". There was a bottle of Soviet-made serum, one syringe and one dull needle for 110 PW's. The first man in line had hepatitis. Within a week 35 others had it.*

Hepatitis, or yellow jaundice, is a liver disease. When you have it, you don't want to eat but you must. We force-fed men to keep them alive - pushing rice or anything else available down their protesting throats. We also tried to keep them off duty as much as possible for about six weeks after the jaundice had subsided.

The loss of appetite from this disease is terrible. I know because I had hepatitis twice. The other doctors kept me alive by force-feeding me. At the time it was rugged and I hated them for it - but today, needless to say, I am grateful.

***IX LICE**: As a prisoner of war you will get to know many representatives of the animal kingdom, among them the louse. This six-legged insect can kill you. There are some 5600 cc's of blood in the body of a normal man of average size. A single louse sucks one cc of blood a day. A louse-covered man soon dies.*

In Korea no PW died of any louse-borne disease. I credit this to immunizations. Do keep your shots up to date. However, lice can bleed you to death unless you pick them off every single day. Never fail to do this even though you are cold, tired and sick, whether you are a PW or evader.

One PW complained of being weak and tired. In our makeshift hospital, next to the equally makeshift morgue, I unbuttoned his jacket and shirt and pulled up his undershirt. He was a mass of moving gray bodies. Lice were so thick I could not see his skin. That man was literally being bled to death.

You must pick lice off frequently, for they breed faster than rabbits. Regardless of how cold it is, you must inspect your entire body and every seam of every garment at least once a day, picking off every single louse. Louse hunting does more than just keep the bug from killing you. It not only provides diversion and entertainment of a sort, it also keeps you busy. Purposeful occupation is important beyond measure if you are an evader or PW.

***X. WORMS**: You will get worms - all kinds, round, hook, and plate worms. They will come from the food you eat and the dirt and filth where you live. Some will look exactly like angle worms five times enlarged. Although there are other symptoms, positive proof that you are infected is when a worm crawls out of your nose. That undoubtedly will shake you up a bit. It always does.*

Personal hygiene is the best preventative measure against parasitic infestation. You may not be really clean from the day you go down until you get out, but there are things you must try to do. Wash your body and clothes as often and as well as you can. And above all, pick lice off at least once a day.

Depending on supplies, there is a worm remedy: Swallow a couple of tablespoons of kerosene or gasoline. Kerosene is more effective but gasoline will do. Either will make you a bit sick, but will make the worms a lot sicker.

***XI. PNEUMONIA**: You will encounter disease and your resistance to them will be low. Pneumonia is probably the most common, especially in winter and it makes you extremely sick. You will have no penicillin, no tetracycline, not even old-fashioned sulfa. (In Korea, I had 250 sulfanilamide tablets for more than 2000 men.)*

When a man has pneumonia in primitive circumstances, there is only one thing you can to for him, even though it is not in any medical book - keep him on his feet. You should not keep a sick man on his feet 24 hours a day but don't let him lie in a corner, pull something over his head, and roll over to face the wall. If he does this, he will die. You must keep him alert and interested, or he will not live.
got frightened, laid down, gave up, and died within 24 hours.

***XII. BLEEDING**: Here I want to make a plea: If you are bleeding, DO NOT put on a tourniquet. I believe more men lost arms and legs as a result of tourniquets than from one type of war wound. A tourniquet destroys tissue, gangrene sets in, and it is often impossible to save the injured member.*

Just apply heavy, constant pressure - that alone will stop 90% of all bleeding. If blood is spurting out, stick your finger down on the wound and hold it there.

***XIII. BURNS**: Suppose you are burned. The book says to wash out the burned area and to cover it with a sterile dressing. What, you ask can you wash it with when there is no water or none that can pass in the dark as sterile? Well, every man has his own supply of one of the most sterile liquids you can find - his own urine. This is just one of the small bits of knowledge you may find able to put to good use. Trying it under extreme circumstances will not hurt you and may save your life.*

As you read earlier, tannic acid is good for burns, as well as dysentery. There is tannic acid in strong boiled bark and tea solutions.

XIV. THE WATER CURE*: Hot water probably saved the lives of more prisoners of war in Korea than any other measure or remedy. We used hot water to treat men with everything from headaches to athlete's foot.*

For a while men came in and gave us long lists of symptoms, before asking, "what do you suggest?' Our prescription was usually "Go soak it in hot water." After a while they began to say "Doc, I've got thus and so. Now I know you're going to tell me to go soak it in hot water, but I just want you to know about it anyway."

Maybe hot water didn't help in every case, but soaking kept the patient busy doing something that seemed reasonable and purposeful. A man who sits for two or three hours soaking a toe or hand, usually doesn't dwell on his unfortunate situation. He's too busy thinking about the cure he's effecting, or how much better his toe or hand feels. (For stomach aches, we might use a variation: Heat a brick and put it on your tummy.)

XV. WOUNDS AND SURGERY*: There are three treatments for a wound under extreme conditions: Clean it out if possible with hot water; wash it out with urine; and/or pick out all foreign matter. The book says never to stick your fingers in a wound. If you have nothing else and if there are pieces of metal or bits of clothing in the wound, pick or dig them out with your finger.*

Maggots were an accepted treatment for infected wounds during World War I. Maggots eat only dead tissue and will clean out a wound better than anything else except surgery. How, you ask, do I get hold of maggots? That's easy if you are anywhere in Asia - just expose the wound, the maggots will find it.

If surgery of any kind is required, remember that the area of the wound is dead. When you realize, there is no feeling in a wound, it is easier for you to stick a needle into it, to cut or to do whatever is necessary. (We had to amputate a few toes as a result of frostbite. For the first six months we had little ether, but later there was no anesthetic.)

You may never have to use a knife to lance boils, cysts and the like; but if you do, soak the area in hot water for a couple of days then, if it is still necessary, open it up.

A most successful hemorrhoidectomy was performed in our camp. A Major had a terrible hemorrhoid that bothered him dreadfully. He limped about for days, soaking it in hot water as often as possible. When the condition failed to improve, he came to me. As he bent over for me to examine him. four trusty colleagues grabbed him. I whipped out my trusty surgical knife, patiently sharpened to a razor's edge on stones but originally a steel arch support from a boot. Out came the offending hemorrhoid despite the patient's belligerent screams and profane threats. The operation was extremely successful. The patient not only lived, he lived in considerably greater comfort.

XVI. MEDICAL SUMMARY*: You of course, know all the basic first aid the Air Force has exposed you to. And, of course, if possible, you will have with you a standard first aid kit, as well as your own special one (having such kits is a real luxury). In addition, you must face the possibility or even the probability that emergency treatments may extend far beyond those normally covered by peacetime, ZI first aid. You must also face the very real probability that you may be the only person available to perform such treatments. Under such circumstances, you must use what God gave you - your head and your hands.*

Men with chest wounds - open, sucking wounds - have stuffed them with handkerchiefs or torn shirts and kept going. Men have broken their backs when they bailed out or hit the ground. After regaining consciousness, they have rolled around for a stick or board, strapped it to them in a fashion and moved on. Men with severe wounds have amputated a limb, whittled a crutch, and kept going. Many things are possible to those with will and determination.

***XVII. THEFT**: In a prisoner of war camp you learn not only to scrounge but also to steal proficiently. When I got back to the United States, it took me a long time to learn to keep my hands in my pockets when I walked through dime stores.*

Sometimes you steal because an object is useful to you. More often you steal things you know you can't use. We figured that everything cost the Communists money or effort, so that we made additional money or effort necessary when we stole any item. Also, thievery built up our morale.

One enlisted man in our camp was a professional thief who perfected his calling at the Communists' expense. The Chinese camp commander eventually became so enraged that he called in our man. When the PW returned, we were curious about what had happened. He explained that he stood stiffly at attention while the commander chewed him at length (and in Chinese) about his thefts. "He was so hot about it, that he impressed me. If fact, I think I ought to take back his watch and pen that I just lifted."

In the camp known as "Death Valley", we stole a complete building. The Communists had let us build a little hospital, and had given us two 55 gallon drums for a stove, but wouldn't give us and wood for it. Nearby there was a wooden building, with mud plaster on the outside. Over a period of two weeks, we surreptitiously took board after board from that building until only the thin plaster shell remained. One night we finally knocked that down, removing the last boards and every piece of straw. The Chinese didn't realize the building was gone for two weeks, and by then we had burned the evidence in the hospital stove.

I was called in for questioning as to what had happened to the people's building. I could only reply that there was no such building. When they looked at the place where the building had been, there was only a bare spot. How could they accuse me of stealing a building? It was too ridiculous!

You may occasionally get caught in such thefts, but usually it's worth it. Through such activities you can pay the enemy back for his harassment. Sometimes your thefts may even cause your captors to cease harassing activities. In any event, you have a lot of fun outwitting them.

***XVII. KEEP A SENSE OF HUMOR**: Humor is important in a prisoner of war camp. Even though everything around you is tragic, you must laugh to sustain your will to survive. You have to consciously work to retain a sense of humor, a sense of the ridiculous. If the Communists tie you up for some reason, you must be able to find humor in the fact that you can tie better knots that two of three of them are doing.*

I actually laughed at men dying. There were symptoms you could assess without being able to describe them: a listlessness, a look, turning from reality. When these symptoms appeared in various degrees and varying combinations, you could estimate very closely how long a particular man you had come to know well would cling to life. Another doctor and I had a running bet on life expectancies. Even though I made money on the deal, I hope to never have to face such a situation again.

We used our sense of humor rather effectively in a perverted sort of counter-harassment. Americans are the most unpredictable people in the world - and methodical types like the Chinese Communists were unstrung when they could not anticipate what we would do next. We encouraged this by deliberately moving along in one direction for a while and then without warning making a complete 180.

Such activities seemed to us our little contribution to the war effort, that we had a mission of some sort. Our PW camp was our "front", a small but active area of combat. Although we had no orthodox weapons, we inflicted what damage we could to the enemy we encountered.

Some camps had one guard for every two or three prisoners. Primarily because they couldn't figure us out nor anticipate our actions, we had two guards for every PW. A small contribution to the total war effort? Perhaps but it gave us a sense of accomplishment and it did tie up a number of Chinese.

It's hard to say which we enjoyed more, our pleasure in a prank for our own sake or the confusion we could create by it. For example, the Commies had a 50-foot pole lying on the ground, ready to be raised as a flag. We stole the pole, sawed it up and burned it. One PW got 30 days solitary for it but, after all, somebody had to be punished and the antic was well worth it.

Right in the midst of the big germ warfare campaign, we caught a rat. The rat acquired a parachute and a USAF tag before being hung on a bush by the front gate. The chief commissar, a dainty air-fairy type, found it. He jumped four feet in the air, did three double flips and raced hysterically back to his headquarters. Then the officials came out to investigate, and to take pictures for their "proof" about bacteriological warfare! We roared with glee, to their complete confusion. That spoof had us laughing for weeks and such laughter kept us alive.
One PW calmly walked up to a guard, socked him in the nose, grabbed his gun, tossed it over the fence into a rice paddy, and just as calmly walked away. It was marvelous because the guard could do nothing without risking punishment himself.

In every group there are characters. Look for them and encourage them to dream up stunts to make the group laugh and to confuse your captors.

***XIX. SUMMARY**: Your chances of survival can be extremely good, even as a prisoner of war, if you do these things:*

** Exercise your leadership responsibilities*
** Maintain military and self-discipline*
** Keep up your own and other's morale*
** Recognize and control fear*
** Keep on your feet, keep going*
** Eat everything you can get hold of*
** Nourish your sense of humor*
** Keep immunizations up to date*
** Practice survival self-aid and preventative medicine, using common sense and your surroundings.*
** Keep your will to survive*

Training such as is given at the USAF Survival Training School helps tremendously. It especially helps you over the first shock of being an evader or prisoner. You should learn what the possibilities are and face them.

You must master the basic fundamentals of hygiene, survival sanitation, first aid, preventive medicine, and survival nutrition, including securing natural foods and the nutritive values of native food. Training greatly increases your chances of survival.

However, of all the things I've discussed, none is as important as your own will to survive. Regardless of where you are, how miserable your circumstances, what the enemy does to you, MAKE UP YOUR MIND THAT YOU WILL LIVE THROUGH IT. Men who should have been dead simply refused to die. Their secret? They had this idea and kept it despite everything: "I'm going to live!"

Part 3: Summary

Hopefully both sections above have opened you up to how much is possible in a truly austere situation. With basic knowledge, it is possible to manage a wide spectrum of medical problems – of course not to the same level as with modern medical care or even with a decent first aid or medical kit, but it is possible to provide lifesaving and life sustaining care.

Chapter 23: Survival Aspects of Veterinary Medicine

A. Reverting to Animal Agriculture

In a world where infrastructure is poor and movement of food items is limited, many will be forced to live off the land and raise livestock. Gasoline will become a scarce commodity and horses may once again become a primary method of transportation. With this return to agriculture, we will be faced with many challenges our ancestors lived with, but ones that have long been forgotten to most of us. Now, less than 2% of Americans are involved in agriculture and it will be difficult to transition to a self-sufficient lifestyle for most. The following is a discussion about the perceived problems we will face in a post-collapse situation.

Easily imaginable is the increase in traumatic injury as a direct result of handling livestock and farm implements. A simple kick of a horse's back leg or the rush of an angry cow can quickly put your best outdoorsman out of commission for months. You should designate a group of animal caretakers who will become skilled at working with large animals and practice safe handling measures. Several books below address animal handling and behavior and are good references to have.

Contact between animals and humans will increase at a time when sanitation and cleanliness are likely to be poor. We will see a dramatic rise in the incidence of zoonotic diseases, those diseases which are transmitted between animals and man. Infectious zoonotic diseases can impact not only livestock production but also those who work with livestock. Food- borne illness will become a major problem as refrigeration becomes difficult to obtain and hunger/starvation overrides the necessity of thoroughly cooking meats.

The following are a few zoonotic diseases of concern, listed in no particular order. The list is limited, however, by the author's lack of familiarity with veterinary diseases outside of the United States.

Parasitic Diseases:

Larva migrans- Describes disease caused by migration of immature worms (larvae) through different parts of the body. The cutaneous form is caused by larvae penetrating and migrating in the skin, resulting in raised, reddened tracts in the skin. It is commonly caused by hookworms, which are carried by most domestic animals—hence the reason for not walking barefoot in pig pens. Visceral and ocular larva migrans occur in the internal organs and eye, respectively, and are caused by ingesting roundworm larvae. To protect yourself, always wear shoes around animals and wash your hands thoroughly after handling animals or animal waste.

Cryptosporidiosis- Protozoal disease that is highly infectious and a common cause of diarrhea in calves, esp. dairy calves, though it can affect all mammals. It is usually a disease of very young animals, newborn to 3 weeks of age, but it can be found in contaminated water sources as well. In humans, it causes

profuse watery diarrhea, nausea, stomach cramps, fever and poor appetite. These symptoms typically resolve in 2-3 weeks in a healthy adult. The protozoa can live for up to 2-6 months in a damp environment, resulting in continued infection of both animal and man. It only takes a very small amount of the organism to make a person sick. If a calf develops diarrhea, you should quarantine it if possible. Always wash your hands and, if possible, wear gloves around the calf. Avoid drinking from contaminated (downstream) water sources.

Trichinellosis- Adult worms produce eggs which hatch into larvae that enter the blood stream and form cysts in muscles and organs. The cysts appear as small white, lemon-shaped capsules in the meat of wild animals and livestock (usually pigs). Humans become infected when they eat undercooked meat that contains cysts. Symptoms include vomiting, diarrhea, muscle pain, headaches and fever as the larvae migrate through the intestines into muscle and tissue. To prevent disease, all meat should be cooked to an internal temperature of 160°F (70°C). Freezing meat also kills the trichinella worm.

Bacterial Diseases:

Brucellosis—A disease of cattle, goats, sheep, pigs and dogs that may cause late term abortions, infertility, and inflamed testicles in affected animals. Humans can be exposed by contacting the placenta or fetus, drinking milk, or when slaughtering an animal for meat (esp. pigs). If humans are not treated immediately after exposure, they may succumb to severe, debilitating and chronic disease characterized by intermittent bouts of fever, headaches and general weakness. This disease is also called "undulant fever". Never perform reproductive work on an animal without gloves on, always wash hands thoroughly after handling reproductive tissues and only drink milk that has been pasteurized or boiled.

We have nearly eradicated brucellosis from cattle in the United States, but it remains in wild populations of bison, buffalo and elk in certain parts of the country. Domestic animals can become infected from these wild animals, and with a breakdown in monitoring and control of foreign animal diseases, brucellosis will likely begin to spread across the country. The disease is uncommon but still a threat in the other listed domestic species. Worldwide, brucellosis is still a disease of concern.

Leptospirosis—Leptospirosis is one of the most important zoonoses worldwide. Dogs, pigs, cattle, rats and wildlife serve as a source of infection with this bacterial disease. The organism is passed in the urine, and animals or humans become infected by drinking contaminated water or by contact with the urine of infected animals. Large outbreaks can be seen after floods. Animals may show signs of fever, jaundice, red urine, late pregnancy abortions or may show no signs at all. In many human cases, the symptoms are mild or go unrecognized. People typically exhibit a sudden onset of fever, headaches, conjunctivitis, muscle pain, nausea/vomiting and diarrhea. More severe cases lead to liver or kidney failure which could be life threatening. To prevent exposure, warn animal health workers to wear protective clothing to avoid direct contact with tissues and urine and all group members should avoid drinking, bathing and swimming in areas where leptospirosis is known to occur. Practicing good rodent control can also help decrease environmental contamination. Those working in contaminated environments, esp. where flooding has occurred, should also take precautions.

Tuberculosis—This chronic bacterial disease typically affects cattle. It can spread to humans by inhalation of aerosols from a coughing cow or ingestion of unpasteurized milk. Bovine tuberculosis has been eradicated from most of the US states, though a few infected herds remain, and there is a potential for a comeback of the disease in the event of a breakdown of regulatory agencies. Infected cattle can

show no signs of illness until late in the course of disease, leading to infection of many cattle and people before it is detected. Many chronically affected animals show emaciation, weakness, inappetance, and moist coughing. In humans, the bacteria usually attack the lungs and cause fever, cough, chest pain and lymph node enlargement inside the chest cavity. Some humans show no signs of illness after infection but may develop disease years later. Most current human cases of tuberculosis in developed countries occur because of exposure to another person with the disease. As a safety precaution, try to avoid being near a person or cow that seems ill and is coughing. You should also pasteurize or boil milk before drinking it.

Other Notable Zoonotic Diseases:

Rabies—A very severe, fatal, viral disease that causes neurologic (brain) problems in humans and animals alike. Raccoons, skunks, foxes and bats are wildlife that carry the disease and can pass it to humans or animals by biting them. Affected animals exhibit strange behavior such as unusual friendliness, fear, or aggression. Many animals that are active only at night will be seen in the daylight. Some animals become paralyzed, drool or have a change in the sound of their voice. Any animal showing these signs because of rabies infection will die within 7-10 days. People are usually exposed from the bite of an infected animal or by contacting an open wound with saliva from an animal with rabies. In humans, signs of rabies develop 1-3 months after exposure. Early symptoms include fever, headache, itching at the site of the bite, confusion and abnormal behavior. As the disease progresses, they become over-sensitive to light and sound, have difficulty swallowing and a exhibit fear of water. Death occurs within days of the onset of these symptoms. There is no treatment or cure for the disease.

Worldwide, more than 55,000 people die every year from rabies and the most common cause of exposure is from unvaccinated dogs. In more developed countries, though, good vaccination programs have been put in place and wildlife exposure is the most common cause of human and animal rabies. With the collapse of society, however, immunity to rabies in our domestic animals will wane after several years and we will begin to see rabies in dogs again. Always be alert and cautious around animals exhibiting strange behavior, signs of brain problems, or salivating excessively. If you believe you have been exposed, the most important thing to do is immediately wash and scrub the bite or contaminated area vigorously with soap, then seek medical attention to receive a series of anti-rabies injections. To prevent rabies in your community, a vaccination campaign for dogs should be held if possible. Loose or wild dogs should be rounded up and impounded or euthanized to prevent future human exposure.

Plague—the cause of the infamous Black Death in Medieval times. It is carried by wild rodents such as prairie dogs, chipmunks, wood rats and ground squirrels, particularly in the Western US. Animals and humans can contract the plague by the bite of an infected flea which came from an infected rodent. Cats are also highly susceptible to plague and can be a source of infection. If your cat develops swollen lymph nodes under the chin and you are in a plague-endemic area, use extreme caution when handling the cat. The disease can also be transmitted between humans by a cough or a sneeze. Humans can develop three forms of the plague: bubonic, septicemic, and pneumonic. Without prompt treatment, the disease can lead to serious illness or death. To protect yourself from disease, protect yourself from flea bites. Use good rodent control and tuck pants into socks when working or playing outside and avoid areas where large groups of rodents die suddenly.

Tickborne Illnesses- There are multiple diseases that are carried by ticks around the world. A few of these diseases are Lyme Disease, Rocky Mountain Spotted Fever, Ehrlichiosis, and Tularemia. Use effective tick prevention when outdoors, if available, and vigilant checks for ticks when outdoor work is done. Most tick-borne diseases require the tick to feed a minimum of 12-24 hours for disease transmission to occur. Early detection of ticks is important. Treatment for these diseases in an austere situation will be limited to symptomatic. The antibiotic doxycycline is a good antibiotic choice to use if a tick-borne illness is suspected, if the medication is available.

Resource for tick borne diseases: http://www.cdc.gov/ticks/diseases/

The zoonotic diseases discussed above are, I believe, the ones of greatest concern in the near future. Many of them can be encountered worldwide. They have the potential to affect many people in a community, cause severe illness, chronic illness, or may be commonly encountered. There are many other diseases which can be transmitted between animals and humans, though. Just a few of them are influenza, West Nile virus, hantavirus, Orf, toxoplasmosis and ringworm. Diseases transmitted through milk include the already mentioned tuberculosis and brucellosis but also Q-fever, *Salmonella, E. coli, Chlamydia* and *Listeria.* If you already have milking animals and are able to, you should contact your veterinarian to perform diagnostic tests to prevent the transmission of milk-borne diseases. In addition, pasteurization standards are easily found, but as a rule if you heat milk to 161°F and maintain that heat for 15 seconds it is considered to be pasteurized. Food should always be handled safely and cooked thoroughly to prevent contamination and food-borne illnesses such as *Salmonella*, *Campylobacter* & *E. coli*.

Resources for zoonotic diseases: www.cdc.gov www.cfsph.iastate.edu

B. Raising Livestock

If you are preparing for collapse, you may choose to raise animals for food. The following is a collection of thoughts on several factors to consider in your preparations. To begin with, the species of livestock you keep will depend on the geography of your area. Cattle and sheep are best suited to pasture land, while goats prefer wooded areas. Pigs and rabbits can be raised almost anywhere, if there are resources nearby with which to feed them. Ducks, too, are quite adaptable and require a pond with a small shelter from predators. The type of animal you raise should also be dictated by the amount of time it will take you to consume their products. For instance, if refrigeration is not available, meat and milk will spoil quickly (except during winter months). Butchering a cow will obviously yield much more meat than a goat or a rabbit. A large community would benefit from a lot of meat but for most, raising smaller livestock makes more sense. Another consideration is the time it takes for your livestock to reproduce. The length of pregnancy for a cow is 9 months, sheep and goats require 5 months and the gestation period for pigs is even shorter, at a little less than 4 months. Rabbits are pregnant for only 30 days and it takes a similar amount of time for chicks to hatch. Number of offspring is also important—cows typically give birth to a single calf, goats and sheep to two or three, while pigs and rabbits are litter bearing species, commonly delivering 8-12 live young each pregnancy.

Finally, several livestock species are considered "dual-purpose", producing more than one kind of usable product. Cattle and goats are typically used for either meat or milk, sheep produce both meat and wool,

ducks and chickens give both meat and eggs, while pigs and rabbits produce only meat for consumption. Of course, the skins of most animals can be processed to make usable leather.

The decision to raise livestock as a food source is a wise one. You will find a list of books at the end of this chapter to aid you in this venture.

C. Common Veterinary Problems

Once you are successful in raising animals, you may find yourself faced with one of many animal medical problems. In the absence of a veterinary professional, there are things you can do to help treat the animal, potentially saving its life. As with all other medical advice in this book, we urge you to seek out a veterinarian's assistance if at all possible and use this information only if that help is not available.

Difficult Birthing (dystocia)

One of the more common problems you will encounter with livestock is a difficult birthing. Most animals are able to breed and give birth to live young with no problems, but you will occasionally need to assist the dam. Here we will reference goats (doe) and their offspring (kids) but the same principles can be applied to cattle, pigs, sheep and horses.

The normal length of pregnancy varies in livestock species from 30 days to 9 months – see the above paragraph for specific times. Horses are pregnant for slightly less than 12 months. As a herdsman, you should notice any animals that may be in heat so you can predict when they will give birth. Most of the time you will just see the female being mounted by the male or other females, but other signs are often present – swelling of the vulva, slight vaginal discharge and loss of appetite (pigs especially). After you see these signs and if the female gets bred, you can calculate when to expect her to deliver. In most species, confirming pregnancy will be difficult in an austere situation and your best indicator that the female is pregnant will be when she does not come back in heat. The exception to this is cattle. With a little practice, you can reach your arm inside the rectum (up past your elbow or so) and feel the calf in the uterus below. Human pregnancy tests do not work on animals.

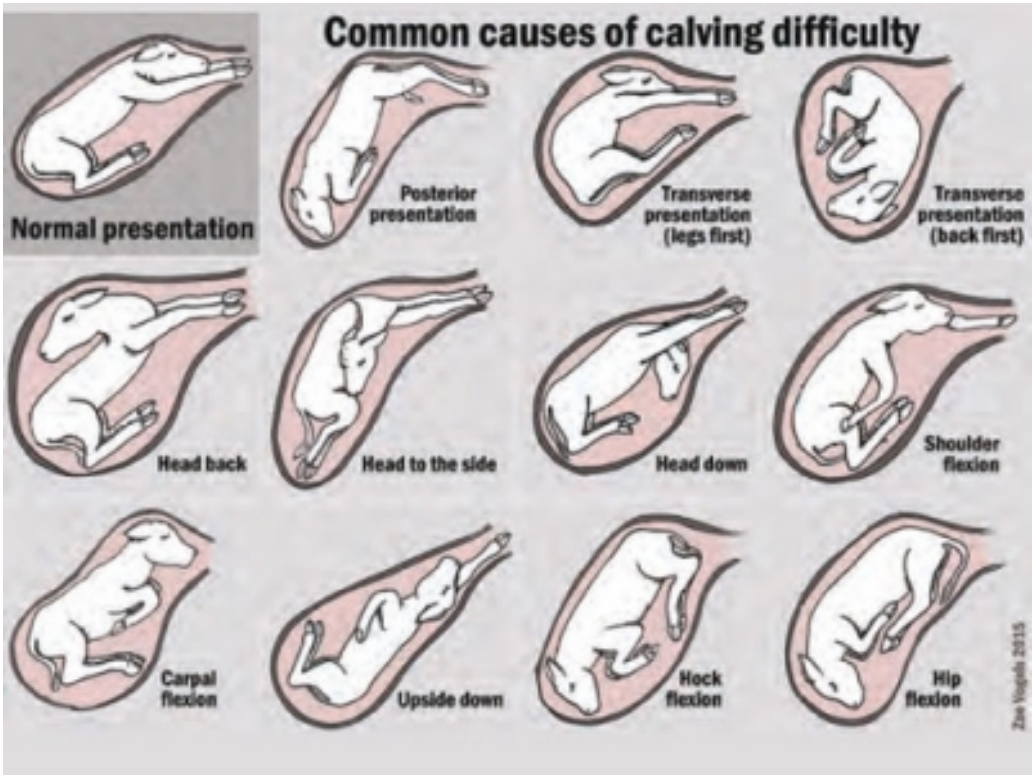
During gestation, you should feed the doe a little more than usual, since she will be feeding herself and her baby. As her delivery date gets closer you will notice that her belly looks bigger, then her milk bag will start to get bigger as well. Most animals "bag up" or start to develop their mammary glands one to two weeks before they give birth. A fairly reliable indicator of approaching parturition in pigs is the production of milk—you can gently squeeze the teat and when you first see droplets of milk you may expect them to farrow within 24 hours. Animals will also exhibit nesting behavior and begin to prepare a place to have their young several days to a few hours before they give birth. Goats tend to paw at the ground, pigs will gather straw, leaves or loose material and chomp it up into smaller pieces to use as bedding, rabbits will begin pulling hair and make themselves a nest. The expectant mother usually goes off away from the herd to have her young, or you may notice that she didn't come up for feed with the rest. Approximately 12-24 hours before delivery, the doe's vulva will get large and loose, and around her tail will feel very loose in preparation for delivery. You should start to check on her more often once you see these signs.

Most animals will lie down to deliver their young, but some may stand. You will see them begin to have stronger contractions which will result in the delivery of their kid. A first time mother will take longer to deliver than an experienced doe. Quietly watch the doe or check on her hourly to monitor progress. Once her contractions become very strong, you should expect delivery within 30 minutes or so. Sows should deliver a piglet at least every 20 minutes, though it is oftentimes every 10 minutes. If you see the mother straining very hard for a long time with no progress you should try to assist her. Once you decide she needs help, do so quickly. The longer you wait the more tired she becomes and delivery will take longer.

Just as in human deliveries, it is very important to be as clean as possible. Use warm water to clean around the doe's vulva, wiping off any feces and dirt. If you have soap, you should use just a little to scrub the area with the back of your hand, then rinse it away. Equally as important is cleaning your hand and forearm—scrub well for several minutes. Long, thin gloves called obstetrical sleeves (OB sleeves) are made for this purpose and are worth having if you can obtain them.

Squirt some lubricating jelly onto your hand and gently reach into the vulva. Depending on the progression of delivery, you will probably feel the kid in the birth canal, but it could also be a little farther up the uterus. Use your fingers to gently explore the body part you can touch to determine what part of the kid it is. Normally, kids are born front feet first and the head facing out, so more than likely you will feel one or two feet. You could even feel just a head. Your challenge is to figure out what part of the kid is coming and move the kid around so it can be delivered. Sometimes one front foot will be flexed backwards, or the head turned to the side. These are easy problems to fix and you should be able to move the body part into place easily. Gently push the kid back up into the uterus to give yourself enough room to pull the leg or the head forward. Once it is positioned, you can grab the kid by the front legs and gently pull it toward the outside to speed things along. Occasionally, a kid, lamb, calf or piglet may be born back legs first. This may be a little more difficult for the doe, but the kid should be able to come out just fine.

It can sometimes be difficult to move a kid around while the doe is giving birth. Just be patient. Use A LOT of lube to keep things slippery, and try to work between contractions. Whatever position the kid is in, you should gradually try to move it so that the front feet and head are coming out first. Try for 10 minutes and if what you're doing isn't working, then stop and do something different or let another person try. Trying for too long with no success just tires you and the doe, stresses the kid and will deplete the normal slippery lubrication around the kid.



This picture demonstrates the normal presentation for delivery of a calf as well as common abnormal presentations. It may help you imagine what you are feeling as you try to assist the doe) http://www.ruralnewsgroup.co.nz/

The most common cause of difficult calving in cows is that the calf is too large to fit through the cow's pelvis. If you find this occurring in your herd frequently, you should use a different bull to save yourself trouble. A good rule of thumb is that if you can pull the kid into the entrance of the birth canal with both feet and the head facing out and your fingers on top of the skull, the kid should fit through. As the kid comes through the canal sometimes the shoulders may get stuck. If this happens, push one shoulder back and pull the other out. If it is a tight fit, you may use some obstetrical chains in double half-hitches above the fetlock (wrist) to gain better traction. Alternate pulling one front foot, then the other, until the kid is delivered. Do not ever hook the chains to a truck or tractor to pull a calf out! The strength of one or two men should be enough to deliver any calf. A calf jack can be used if one is available. Hook the jack to the chains and place the open end against the cow's back end. Use gentle traction and a downward motion to ease the calf out.

If you cannot deliver the kid, then a c-section is needed. It is a relatively low-tech surgery, but sterile technique is a must. See Chapter 9 for information on surgical technique – while described in human context, the principles apply to ventrinary medicine as well.

Briefly, to perform a c-section on a cow, goat or sheep—shave and scrub the left flank. About midway between the ribcage and the hind leg, make a skin incision straight up and down (the length depends on the species and size of the animal). Spread apart the 3 muscle layers with your hands, rather than cutting them, and cut through the peritoneum when you get there. The pregnant uterus should be close and easily recognizable. Grab the kid's hock or front leg and pull it up and out of your skin incision. Cut through the uterus, avoiding blood vessels and cotyledons (where the placenta attaches). Grab the kid and lift it out, but do not let go of the uterus! Have an assistant help you with this part. Once the kid is delivered, separate the placenta away from your incision, then suture the uterine incision closed. Use a

two layer closure to prevent leakage of fluids into the abdomen – suture the incision closed, then suture the uterus together over the first suture line. Close the abdomen by sewing the peritoneum and inside muscle layer closed together, then the two outer muscle layers togethe, and finally the skin closed. Antibiotics are certainly indicated if they are available. This may be a salvage procedure where you at least save the kid rather than both doe and kid dying from complications.

With a prolonged delivery, the doe can become suffer from a low blood calcium level. Calcium is necessary for muscle contractions, so her contractions will be fewer and weaker. If she has been in active labor for more than a couple hours, you can assume she is deficient. Give Tums (calcium carbonate) as needed to supplement her, or liquid/gel calcium if it available.

Once the live kid is born, you should clean and dry his mouth. Lay him next to the doe so she can finish cleaning him as this is important for the bonding process. The doe should pass her placenta shortly after delivering the kid. It is very important to make sure the kid nurses a belly full of colostrum soon after birth. Within 12 hours is ideal, but you have up to 24 hours to make sure this happens. You may want to help the kid stand and nurse if it is several hours old and hasn't already tried to do so on its own.

Mares (female horses) tend to have fewer problems foaling than do other species. Their uterus is easier to tear than other animals, though, so use extra lube and caution if you must help them.

Colic

Colic is a general term for abdominal pain in horses and can have different causes. It commonly happens during or after dramatic changes in weather, with a diet change or from dehydration. The pain comes from the intestines and is due to cramps or when feces become too dry to pass, termed "impaction", similar to constipation. Occasionally, the colic can be caused by something more severe such as when intestines become twisted, but without surgical correction these cannot be treated.

A colicky horse can show one or more of these signs: pawing at the ground, looking at their abdomen, standing with their legs spread out to relieve pressure on the abdomen, walking in circles, kicking at their belly, rolling repeatedly, decreased stool production or depression. Initial conservative therapy for the colic patient can be increasing exercise by walking the horse in circles for about an hour (don't ride the horse, just lead it around). Horses tend to be more sensitive to pain than other animals so it can be difficult to tell why the abdomen hurts or how severe the problem is. Sometimes the colic will resolve on its own overnight.

If the colic symptoms persist, you should try to help relive the horse's pain. The drug xylazine can be used for sedation and flunixin meglumine given for pain. The next step is to pass a nasogastric (NG) tube from the nose down into the stomach to relieve gas and/or fluid that is built up. A special tube with a blunt end is made for this purpose, but in its absence for a standard sized horse you may use a different tube. It should be approximately 75% of the size of a garden hose in diameter. Use a knife to blunt the ends so they are not sharp. Stand to the side of the horse, open up one nostril with your fingers and slide the tube up the horse's nose. The tip of the hose should point up at this point. When the hose reaches the back of the horse's throat, you will feel some slight resistance. Place the other end of the tube into your mouth and gently blow while twisting the tube so the end curves down, and advance the tube. The horse should swallow the hose when you blow and push the tube. Once you feel/hear the horse swallow, continue to advance the tube gently until it won't pass any further. You should be able to feel

the hose pass through the trachea down the left side of the neck. Use a very large dose syringe or suck on the end of the hose to remove any fluid buildup off the horse's stomach (reflux). If fluid comes off the stomach, continue to drain it until no more will come. Oftentimes a siphon will start though you may have to move the hose around some to get all the fluid out. If reflux is present, it means that no food or liquid is making it past the stomach or intestines because they are blocked up. Continue to pull the fluid off until no more will come. Rest the horse and remove any food from their pen for 24 hours.

If you do not get fluid off the stomach, or very little, you may give some mineral oil or electrolyte water to help the impacted stool move through. Be very certain that your NG tube is not in the lungs—you should be able to feel the tube along the left side of the neck and listening in the tube you may hear bubbles in the stomach if the tube is in the right spot. You can also blow in the end of the hose and someone using a stethoscope can hear the bubbles in the stomach. Once you are sure the tube is in the stomach, give 1 gallon of mineral oil to loosen the impaction or several gallons of electrolyte solution. Remove feed until the horse has passed normal stools consistently, often at least 24 hours. To prevent colic, do not change feed suddenly and make sure your horse has ample amounts of fresh water available always.

Lameness

If your working horse becomes lame, begin by looking at the hoof wall and the sole for any obvious wounds. One of the more common causes of lameness is a bruised sole, which can lead to an abscess. The sole becomes bruised when the horse walks on stones, irregular ground or from a poorly fitted shoe. If there are no wounds to cause the horse's lameness, you may initially assume a bruised sole. If the bruising has progressed to a subsolar abscess, you will feel a bounding digital pulse. Lay two fingers just below the fetlock joint on the outside of the leg. The worse the inflammation is, the stronger the digital pulse will be, to increase blood flow to the damaged sole. You can soak the foot in an Epsom salt solution for 10 minutes 2-3 times daily to bring the abscess to a head. You may also place a gauze saturated with Epsom salts and a bit of water on the sole and keep it bandaged. Once the abscess starts to drain, you can pare the sole away to open it up and keep it draining. Be careful not to go too deep, though, as it will take longer to heal. Once you have a draining subsolar abscess, keep the hoof clean and bandaged until healed.

There are, of course, many other causes of equine lameness but they are beyond the scope of this book.

Other livestock species may become lame from time to time, too. It is estimated that 90% of lameness in cattle is in the hoof. You should check the hoof wall and sole for any cracks or defects. Clean it well and if you see any cracks, use a hoof knife to pare them out until you get to healthy tissue. Then bandage the foot well and leave it wrapped for 2-3 weeks to heal.

Castration

When raising livestock, it is a good idea to castrate males you do not intend to use for breeding. Castration involves surgical removal of the testicles and, thus, the associated sex hormone testosterone. Castrated animals are less aggressive toward people and other animals and easier to care for. They also gain weight better than intact males and you do not have to worry about them breeding females. The

meat from mature male pigs that have not been castrated can have a “boar taint”, which is a strong musky flavor to the meat and undesirable to many people.

The process is simple and it is surprising how well farm animals do after surgery in an austere environment. There are many online videos that demonstrate the process, if you have access to the internet.

It is best to castrate farm animals when they are young because they recover better and are easier to restrain. It is possible to perform the procedure on more mature animals, but it will be much more difficult to keep them still. Castrations today are commonly performed on an awake animal with no pain management—economically, it is not feasible to anesthetize and administer a local anesthetic to each calf before surgery. On the farm, a chute can be used to restrain calves, and physical or rope restraint is acceptable in kids, lambs and piglets.

Cattle, sheep and goats have pendulous testicles and are easy to castrate. Use clean hands and instruments—be especially sure that your instruments are not rusty. Rusty instruments are a good way to give your animal tetanus. Push the testicles up toward the animal’s body and pull the scrotum (sac) down. Use a sharp knife or scalpel to cut the bottom 1/3 of the scrotum off. Grab one of the testicles and pull it down, then strip the outer layers up and pull down hard until you feel the testicle release and it dangles easily. You should see the cremaster muscle next to the spermatic cord, which may appear blue from the winding blood vessels. An emasculator is the instrument of choice for clamping and cutting the spermatic cord, but on young animals you may just cut the cord with the knife. More mature animals will bleed more and you should try to clamp the cord for about 30 seconds before cutting below the clamp. This will help the body form a clot and prevent excessive bleeding. If you have emasculators, place the nut side of the tool toward the testicle (nut to nut) and squeeze quickly. The tool will cut the cord and clamp above the cut. Hold it clamped before releasing. Repeat to the other testicle. The spermatic cords will retract into the body when you release them. Reach an inch or so into the cut scrotum and pull down on tissue to feel for any fat. Use scissors or a knife to cut the fat away. If left in place it will swell up and prevent the wound from draining. Spray the area with fly spray, if you have it. Your job is done. Keep the animal from getting in the pond or laying in mud puddles, if at all possible.

If you see major scrotal swelling several days after the procedure, it is likely an abscess has formed and needs to be drained. The reason this surgery can be performed in a nonsterile manner is because the infection is able to drain out of the body. If you did not cut enough of the scrotum off, the outside can seal over before the wound has healed inside. In this instance, open up the wound and allow the abscess to drain. You may have to do this several times before it heals completely.

You should make every effort to castrate your young before they are a month or two old, as you will have far fewer complications. Castrating a horse is a similar process, but their testicles do not descend completely until around a year old and restraining a horse this age will be very difficult without anesthetic drugs.

The testicles of a pig sit much closer to their body than ruminants and do not hang down. To castrate a young pig, have an assistant hang it over a round barrel or pipe fence, holding the back legs in their hands. The surgeon stands on the opposite side. Make a straight line cut over the testicle and pop the testicle out of the incision. The rest is similar to cattle as described above- strip through the outer tunics until the testicle releases, then clamp and cut the cord. Make another incision over the remaining

testicle and remove it. You can just cut the spermatic cord on piglets younger than a month or so, instead of clamping them.

Your patient will be a little sore for a couple days, but should resume eating and drinking normally in a short period of time. Be concerned if they are off feed and lethargic any longer than 24-48 hours.

Another common practice is to band the animal while it is young. This involves applying a very tough and small rubber band to the spermatic cord above the testicle to cut off blood supply to the organs and eventually they will die and fall off. Studies have shown that surgical castration is much less painful than banding and there is less risk of tetanus with surgery as well. Banding has been practiced for years, though, and if used on young livestock it is effective.

Parasites

In an austere setting it will be difficult to obtain newer, synthetic dewormers for your herd. Your best practice is to try to prevent or limit them in your livestock. Do not put too many animals on one pasture. When there are too many animals, it forces them to graze closer to the ground, which is where the worm eggs are at. Goats are particularly susceptible to the barber pole stomach worm, and can become anemic and die easily. Try to keep goats grazing at or above their head level. They really prefer to browse on trees and underbrush anyway.
Signs of parasites can be decreased weight gain or weight loss, lethargy and anemia. Check the inside lower eyelid to assess color. A healthy goat will have dark pink conjunctiva, but an anemic one will be light pink. In severe disease, the goat will develop swelling from edema under the jaw (bottlejaw) or on the legs. Deworm or cull this animal as she will continue to spread worms to the others in the herd. It is okay to eat her. It can also help to co-pasture animals together, such as allowing a horse to graze in with the goats or other species. The horse can eat the goat worm eggs and not be affected by them, and vice versa. As a general rule, livestock animals do not get worms from other species.

Working Dogs

Dogs can serve several useful purposes on a farm. They are especially good at guarding livestock and/or your property, and some can herd or help you move animals when needed.
With the invention of mass produced dog food, it has become an outdated activity to make your dog's daily ration. Presumably, though, you could feed your dog what's on your table and expect them to live a decent life for several years. You risk developing a deficiency of certain vitamins and minerals, but if you cannot purchase human food it is unlikely you will be able to purchase dog food. Do the best you can with what you have and feed a balanced diet with protein and carbohydrates. You can feed them raw meat, and they even derive nutrients from the internal organs. Actually, these parts are generally more dense in vitamins and minerals than muscle. Beware of feeding them cooked bones, though, as you risk puncturing an intestine as the sharp bone moves through.

If your working dog sustains injury, treat it as according to the wound care chapter. Deep muscle wounds should be kept clean and open to heal. Bandaging is great, but difficult on the haired species especially when they can't understand doctor's orders to remain still. It is quite remarkable the power of a little nursing care and an animal's ability to heal despite the odds. The most important part is to make sure they are eating and drinking well. You may need to force food or water down them for a few days to

make sure they have enough energy to fight off infection. Again, keep any wounds clean and draining. Wounds to the abdomen or thorax are likely to be fatal. Bite wounds are particularly challenging to treat because the penetrating tooth places bacteria deep inside the body with nowhere for infection to drain out. Clean them as best you can. Treatment will be difficult without anesthesia in order to open up the wounds. Gunshot wounds to the extremity can heal, provided there are no fractures, but those puncturing the chest or abdomen will probably be deadly. A simple fracture can possibly be splinted for 4-6 weeks and the bone can heal, but if it is open and draining the dog may not survive without veterinary care.

Another somewhat common ailment of working dogs is vomiting & diarrhea, especially if they are scavenging for food or eating spoiled food. Most of the time their body can overcome the infection provided they do not die from dehydration. Combat dehydration with oral fluids. A good rule of thumb for daily water intake is 1 ounce per pound of body weight, so a 50 pound dog should drink around ½ gallon per day. (1 ounce = 30ml. There are 32 ounces in one quart). This is applies to an animal under normal conditions that is not working. A dog that is losing fluid from vomiting or diarrhea requires more water. Try to give twice the daily intake in this situation. If the dog is not drinking, you can use a syringe to force water down him. Insert the syringe (no needle) into his mouth at the corner where top and bottom lips meet and gently squeeze. He should swallow the water or electrolyte solution. You can use bagged IV fluids and give them subcutaneously, as described in previous chapters. The best place to do this is on the top of the dog, over the shoulder blades and neck where there is loose skin. The amount of water given should be the same as orally, but divided into multiple doses throughout the day. If the vomiting is severe, given smaller amounts of water more frequently – i.e. 1 Tbsp every 10 minutes.

Chapter 24: Austere Medicine Sound Bites and Lessons Learned.

There are many sayings in medicine - throwaway one-liners – which are generally easy to remember. Some are almost clichéd. However, they contain valuable pearls of information – most are self-explanatory and require no further explanation. Most are covered in more details elsewhere, but they are easy to remember as one line sound bites.

Also, lurking on the internet are various 'lessons learned' documents both from both the military and from expeditions and disaster medicine experiences. We have reproduced some we feel are the most useful – many themes are similar across many reports, so many have been merged or summarised.

A. Sound Bites

- ***Knowledge is power.***

  Things are not nearly as concerning or scary when you understand it. So it is with medicine. Figuratively, the more knowledge you have in any given situation, the more control you have over that situation. Even a rudimentary knowledge will often make situations much less stressful. Knowledge is also literally powerful in the sense that medical knowledge makes you a "sellable" product and historically places you high up within a community hierarchy.

- ***First, do no harm.***

  "Premum non nocere" or 'first do no harm' has been a tenant of medicine for 2000 years. Anything you do should improve the situation for the patient, not make it worse – when in doubt about the impact of an action – don't.

- ***Masterful inactivity saves lives.***

  Time fixes many things. The ability to keep calm, open an airway, control any bleeding and them simple wait is a powerful medical skill. Sometimes it is much harder to do nothing. But time is often what people need – some basic support, and then someone who is prepared to see what is going to happen without over complicating the situation.

- ***When in doubt, do nothing.***

On a similar theme to the above two sound bites, this one describes having the fortitude to do nothing. If you don't know what is going on, or what needs to be done next – do nothing. By doing so you are minimising the risk or doing harm and allowing time for nature to take its course.

- ***Babies deliver themselves (most of the time).***

For thousands of years, babies have been delivering themselves – if this was not the case humanity would have died out. Sadly, even with the best will in the world, 15-20% will have serious problems and mum or baby may die. However, taking a glass half-full approach it means 80% will not have problems. It also only takes a moderate amount of midwifery knowledge to steer perhaps 1/2 of those who have serious problems to a safe delivery. Nature has designed childbirth to continue humans – most will be ok with support alone or very limited intervention.

- ***The placebo effect has cured more people than any doctor.***

For any given drug, the mind will play an important part in how effective it is – the body can bolster the effects of a medication. It is not universal but for the majority, the placebo effect will enhance the effectiveness of a drug. As discussed elsewhere, for some patients even if the "drug" has no pharmacological effect (i.e. is water or chalk), they will get a therapeutic benefit (e.g. their pain will reduce – in some patients by up to 30% - even if they have just been given a pretend drug). Never underestimate the placebo effect.

- ***If it hurts, rest it or immobilise it.***

It really is common sense, but if something hurts when you use, you rest it. Simple. Absolute rest is generally bad in the long term – but in the short-term, rest is good. After 48-72 hours, gentle mobilisation.

- ***Always wash your hands before touching a patient.***

Germs, germs, germs. They are everywhere. With the discovery of germ theory 200 years ago, we realised that doctors were killing as many people as disease was. Washing your hands is an incredibly simple thing you can do which can genuinely improve health outcomes and survival for your patients by reducing the spread of bacteria and viruses.

- ***It is better to boil all your water than die of diarrhoea.***

  Water borne illness is common anywhere in the world – diarrhoea is one of the biggest killers in the third world – especially in children – most is due to contaminated water. Simple filtration and boiling all drinking water will take the risk of catching water-borne illness to nearly zero.

- ***Don't you (or let anyone else) shit in the water you are going to drink.***

  For most contaminated water ways, the contamination is due to either human or animal faeces. Keep livestock out of rivers and lakes upstream from where you take drinking water. Ensure that toilets are downstream from all drinking water sources and at least 50m away from any water source.

- ***A comfortable warm bed fixes many problems and a good meal fixes many more.***

  It's self-explanatory really. Think of how it feels at the end of a long hard cold day of work out doors with a cough or a cold. You get home, have a hot meal, perhaps a hot bath and get into a nice warm comfortable bed. How does that make you feel? No matter how bad the day is, no matter how miserable you feel – a hot meal and a warm bed makes you feel better.

- ***Direct pressure stops bleeding.***

  It does, it really does. Tourniquets and haemostatic gauze are nice extras, but the reality is, 99% of the wounds you will deal with in an austere situation can be controlled with direct pressure. Never under-estimate it.

- ***Pretend you know what you are doing and most people will believe you do.***

  This ties into the placebo effect. If you come across like you know what you are doing – sound confident, speak knowledgably, show empathy and caring – people will trust you. You don't have to lie, you can be honest about your limitations, but beyond basic competence what most people want in relationship with their doctor/medic is rapport and empathy. The power of good bed-side manor should never go underestimated.

- ***Don't stitch a dirty wound (or one more than 24 hours old).***

Covering up the dirt by stitching the skin over the top of it doesn't make it go away. Dirty wounds will get infected – at best a minor inconvenience and at worst, death for the patient. Irrigate and irrigate some more, the cleaner the wound the better. If the wound is grossly contaminated or you cannot get rid of all visible dirt – don't close it.

Similar rules apply to old wounds – the older the wound the more prone it is to getting infected. Suturing a wound, > 16-24 hours old substantially increases the likelihood of the wound getting infected.

Sometimes it is better to let a wound heal from the bottom-up, even though it will take longer and look worse cosmetically.

- ***Clean boiled water is a great antiseptic (So is urine but we won't go there).***

It has been well studied – when it comes to cleaning or irrigating a wound – tap water or cooled boiled water is just as effective as commercial antiseptics in terms of cleaning a wound.

In a truly austere situation it is worth remembering that, in the absence of a urinary infection, urine provides a sterile, portable irrigation fluid. There is nothing wrong with peeing in a dirty wound.

- ***The key to pollution is dilution.***

The best way to irrigate a wound is to use very large volumes of water. If something is contaminated with dirt and debris, the best way to clean a wound is with volumes of water. Dilute the contaminate with large volumes of clean water.

- ***If you've got a rash: if it's wet, dry it; if it's dry, wet it.***

It's a simple approach, but it will help the clear majority of rashes. It may not cure it, but it will improve it.

A wet weepy rash will get better if exposed to sunlight and circulating air – particularly groins, armpits and under breasts.

A dry cracked erythematous rash will benefit from a mild emollient or a non-perfumed moisturiser.

- ***The first thing to do in an emergency is nothing. Then, take your pulse. If you're not the one dying (or your family), it's not much of an emergency so relax.***

  It probably seems harsh, but this is the reality. In an emergency, if the patient is not you or your immediate family, then you need to take a deep breath and try and relax. If you are wound up and tense or panicking ,you are not helping the patient. A degree of stress is important, but too much stress is bad – you need to relax, take time to focus and then begin caring for the patient.

- ***90% of problems get better by themselves.***

  We have already talked about the concept of masterful inactivity – the fact that often doing nothing is better than doing something. The reality of medicine is that many problems will get better no matter what you do or don't do. The ability to wait out a disease is important. Know when to act, but also know when to do nothing. Time will fix a lot of things.

A. Lessons Learned

- ❖ THE BASICS SAVE LIVES. ABCs and common sense really work and will keep casualties alive.
- ❖ Train everyone in the simple A B C tasks.
- ❖ Train realistically, include rehearsals, and plan for the worst-case scenario. Whenever possible, include casualty play into training. Make the scenarios as real as possible and perform every task as stated in your plan.
- ❖ Always have contingency upon contingency plans. Try to keep them as simple as possible so they will be easier to remember. They probably will never be used exactly as planned, but thinking about different situations and possibilities during training will enable you to make decisions faster and smarter during the mission.
- ❖ Make sure everyone on your team can perform a primary and secondary survey and keep them proficient in self-aid and buddy-aid because it maybe YOU they are working on someday.
- ❖ Always keep bandage material, an airway, a flashlight, and bandage scissors readily accessible on your body in a cargo pocket, or any pouch you can access quickly. If you can maintain the airway and plug a hole immediately, you have bought time until you can move to a protected area and render definitive care.
- ❖ Find an aid bag that is comfortable and practical for you according to the mission. Set it up efficiently and be able to work out of it blindly.

- Always think about improvisation of everything you may need. You cannot carry (or store) enough supplies (i.e. bandages and splints) with you if there are many casualties. Pack multipurpose items.

- Cross load medical gear/supplies on everyone.

- Remember to treat the "whole" patient, not necessarily the "obvious wound". Assess the whole casualty and all wounds while thinking of any possible anatomy that may be involved by all primary and secondary missiles. Do not assume bullets take a straight path from entrance to exit wounds.

- Use different classes of pain meds effectively to keep as many people in the fight as possible. Remember the effects that narcotics will have on casualties.

- Consider early antibiotic use – does the patient need Abs?.

- Continuously reassess casualties.

- Remember preventive medicine and make sure it is practiced (i.e. showers, latrines, water, kitchen, immunizations).

- Fatigue and stress will affect the decision-making process. Stay aware of this and educate your team on this fact. Rest is essential during planning and operations whenever possible.

- In combat people die, and there is nothing you can do to help them. Your job is to save the casualties who have a chance to survive. Make the call and do what you know is right - that is all anyone can ask of you.

- Some patients will have nonsurvivable injuries for the current environment, but still must be cared for ethically and humanely.

- All efforts should remain focused on outstanding patient care to the highest degree possible given the limitations of an environment markedly altered by the disaster.

- Keep medical treatment of injuries as simple as possible.

- Listen to one's intuition and speak up to the group leader and wider group accordingly.

- In the backcountry, events outside of our control will occur. We must attempt to mitigate as much risk as possible, but must remain aware that serious events will unfold regardless of planning.

- You are expected to make pain manageable; not take it away completely – this would be total anesthesia.

- "Cookbook" formulas are only starting points. Every patient is unique and requires a tailored approach.

- Know all your drugs inside and out.

- Take care of your medications – if they fall outside temperature range, they may lose efficacy.

- Remember, many of your patients will get better **in spite** of what you've done, not necessarily **because** of what you've done. Provide good nutrition and rest and the body can work wonders at healing itself.

- Always consider how the patient is actually doing clinically. Are they talking, alert, eating well? If the clinical picture doesn't match the problem you are aware of, perhaps there's something you're missing. For example, if a large laceration is clean and healing well but the patient feels terrible and won't eat, maybe you should think about looking for other causes of their illness.

Chapter 25: Survival Medicine Fiction

Survivalist fiction has always been relatively popular with people interested in preparedness. It provides an opportunity to think about possible scenarios and consider how you would respond in a similar situation and of course some escapism. We have included two pieces of fiction, which look at medical care in a major long-term disaster situation. In addition, several other survival fiction novels cover some medical scenarios; these include "Patriots" by James Wesley-Rawles and "Lucifer's Hammer" by Larry Niven and Jerry Pournelle.

1. This article was found as a text file on a survival orientated website several years ago. We have been unable to verify where it was first published – we think it appeared as a magazine article in the 1980's. It is reproduced here in good faith with due credit to the author and we would be very happy to hear from anyone who can identify its origins or contact details for the author.

(Editor's note: The dose of Lidocaine described in this work of fiction is excessive and would potentially result in a significant overdose if given to a patient. The recommended maximums are 3-4mg/kg without adrenaline or 5-6mg/kg with adrenaline)

Amputation by Steve Gilley

It was obvious that the badly mangled leg was dead. Dave knew that amputation was the only way to save Jack's life. The infection was starting to spread from the dead limb upward towards the trunk. The lower part of the leg was black and foul smelling, and the red streamers of blood poisoning were ascending like ribbons of death. For the last week, Dave had administered Demerol for pain, and ampicillin to combat the infection. They had lost the battle. Jack now had a temperature of 104 degrees, and was delirious much of the time.

Dave studied the book for over an hour, making notes and highlighting pertinent data. He chose Cheryl to assist in the operation. She was flattered, and at the same time frightened. "I've never done anything more serious than take out a splinter or clean up a cut before." she said, "but I think I can do it."

"You'll be great" he told her. "Here's a list of the stuff we'll need" He handed the list to her and told her where to find the material in the medical supply closet of the shelter. "Have your mother help you."

The Kitchen. The operation was to be performed in the Alcot kitchen. Nick found an old door in the garage and supported it between two sawhorses to make an operating table. Dave checked it and found the working height to be too low. After a short discussion, it was decided to rest one end on the kitchen table and the other on an upended footlocker. Anne placed a mattress on the door and covered that with clean sheets. It was the best they could do.

Cheryl, now chief scrub nurse and assistant surgeon, prepared the top of a tea cart to serve as an instrument tray. The instruments were placed in a pot of boiling water atop the kitchen stove. Two items would not fit into the pot so Anne bought an oval roaster from the shelter to accommodate the mechanic's hacksaw with two extra blades and the long frozen-food knife that Dave had requested.

"Where did you get all of these?" Cheryl asked as she removed the hot instruments from the pot a half hour later.

"Oh, some of them I bought new. A lot of electronic tools are based on surgical instruments. Some I got at auctions. Once I found an old doctors bag full of these types of things at an auction. I always thought they might come in handy someday." Dave answered. "I paid three dollars for the whole bag if I remember correctly."

Cheryl continued to put the instruments neatly on the towel draped tea cart: two glass syringes, three scalpel handles – their blades not yet attached – nearly a dozen hemostats, scissors, and the long, serrated knife. The hacksaw was last. She handled it as if it were a snake. Sutures – Dave pawed through the pile of little foil metal packages and selected a variety of scalpel blades and pre-packaged sutures, needles already attached. He laid these out neatly on the tabletop. Gauze pads, called sponges in medical jargon, were piled on another tray along with ace bandages, gauze, and adhesive tape. A bottle of Demerol (editors note = Pethidine), a 200ml container of Xylocaine, antibiotic salve and Vaseline completed the list. "Do you know why it's called Vaseline?" he asked holding the jar in his right hand. "No I don't" Cheryl answered. "Because the guy who invented, it mixed it up in a vase belonging to his wife or mother. Lots of products names ended in the suffix – "line" or "tine" in those days, so he called it "Vaseline". That's your trivial lesion for today" he laughed, and placed the jar on the tray. He then positioned a large pail under the table. "That's for the garbage, the foot, and lower leg," he advised.

Dave was not a stranger to operating rooms. During a two-month period, in 1978, a doctor friend of his had allowed him to observe activities in the Emergency Room of the local hospital where he was a resident. This was at a time that Dave was avidly preparing the shelter. He had felt that some practical experience was needed in the medical field. He had experienced some bad moments, watching his friend patched up damaged arms, legs, and heads on Saturday nights in the Emergency Room, but the experience had been enlightening. He wished his doctor friend was here now.

"Bring the patient in now," he told Nick and Anne. Jack Padrewski, sedated by a combination of Demerol and Valium, was sitting the next room, his wife Cindy, at his side. She was crying, but rational. "Jack, its going to be ok," she sobbed, "Dave has all the stuff to do the job". She couldn't mouth the word "amputate",.but she added, "You'll be up and around in a few weeks." "Uh huh," he moaned, "I love you, Cindy."

Anne and Nick arrived to take him to the kitchen. "Lay him on the table." Dave ordered gruffly. "Good lord, Dave, you have only been a chief surgeon for about 30 seconds and you are getting arrogant

already." Nick chided "Sorry." Dave apologized. The preparation went smoothly. Cheryl removed Jack's trousers, washed his leg in antiseptic soap, and shaved the entire leg from the wounded area to the groin. Dave checked the man's blood pressure and found it acceptable. His breathing was easier now. The Demerol was doing its job. They were nearly ready. Dave and Cheryl scrubbed their hands for ten minutes, dried them, and put on sterile rubber gloves. "I guess this is it kid," he said to her. "You okay? No puking, no fainting?" "Yes, I'll save that for after," she said.

By the book – Dave pulled his surgical mask up over mouth and nose. Cheryl did the same. He propped the book open to the highlighted page and began. Using a sharp pointed scalpel, Dave scratched a line on Jack's leg 2 inches above the dead tissue. A thin line of blood appeared. "That's where we'll cut," he said. "I think we should open a window or something." Cheryl said. "the smell is getting to me." "It's not very pleasant, is it," he agreed. Then Dave called to Nick. "Hey, Nick, come in here and open the window over the sink about six inches, we've got to have some air." Nick came and left quickly. "That's better." Cheryl said.

Dave drew up 20cc of Xylocaine into the syringe and injected it all around the line he had drawn just under the skin. The skin bulged in response. He refilled the syringe, this time with 50cc of the clear liquid, and using the full length of the needle, injected it deeper into the flesh. He waited five minutes. Then with a pin, Dave tested for a pain reaction an inch below the line. He shook Jack's shoulder and spoke, "Can you feel that?"

"I can feel something – but it doesn't hurt." he mumbled

"Okay, that's normal." he assured him. "Put the tourniquet here." he said pointing to the lower thigh. Cheryl placed the piece of surgical tubing as told, and tightened it firmly. Dave picked up a scalpel and with a long sigh, made a half inch deep cut all the way around the fleshy part of the leg. Blood spurted then subsided. "Use a gauze pad to keep the blood sopped up. I have to see what I'm doing." He said.

Red Muscle – The yellow layers of fat showed. The skin pulled away from the cut revealing small bleeding blood vessels. Cheryl gasped. Red muscle showed below; the bleeding increased. "Tighten the tourniquet." He said. She responded quickly by twisting the wooden dowel that pulled the tubing even tighter. The bleeding lessened. He worked the scalpel deeper into the leg, cutting constantly. Muscles twitched and jumped as he cut them. Cheryl was busy soaking up blood with the sponges. Dave located the artery that was flooding the area with blood. "Got to sew that one up now," he said. "Hand me two hemostats." Using the tools, he grasped the end of the bleeder and clamped it off about an inch from its end. Using a needle holder and prepared needle and fine silk thread, he stitched the flattened end of the artery closed. When finished, he released the clamp and was pleased to see that the repair was holding – so far. "Now for the big test," he said. "Release some of the pressure on the tourniquet." She did. He watched the sutured vessel. It held. "Okay, tighten it up again." He read his notes. "That shouldn't have happened," he said. "We must not have had the tourniquet tight enough. We're supposed to be able to wait until after the bone is cut before having to suture."

The bone – Cheryl twisted it tighter and Dave continued to cut, He had reached the bone. Scraping the muscle attachments and membranes from the bones with the big knife, he exposed about half an inch of them. "Okay, more Xylocaine", he said, picking up a syringe. He drew about 10cc into the tube and injecting it into the tough membranes that covered the bone. "Now the hard part – for you," he

explained. “You’ve got to pull the mass of flesh – meat, if you will – away from the area I’ve got to saw in. See what I mean? Draw it up, and down, so I’ll have room to cut. Hand me the hacksaw”. She passed him the tool, then pulled the lower section and pushed the upper section making the necessary room. “How’s that?” she asked. “Super.” He answered. “Hold it right there and I’ll get to sawing” He grasped the hacksaw tightly, braced himself, and started to saw. Jack moaned, but did not move. It took more than six minutes to complete the task. Bones are hard, he thought. He was sweating badly, even in the cool room. When the second bone parted, he took the useless extremity and chucked it into the pail below. “Okay, now to suture the vessels. Release some of the tourniquet so we can find them.” He told Cheryl. She did so, and the blood spurted. “That’s the big one,” he said grasping the hemostat. “I’ve got it, clamp it with this.” He said, handing her another hemostat. She compressed the slippery pencil sized tube deftly as he prepared to sew up its end. The job went well and he started to relax a little. “That’s the worst of it.” He declared. “Thank God” Cheryl replied.

He sutured the other large vessels and tested his work by having her release the tourniquet. There was no major leakage. “All right” Dave said. “We have two choices on the minor bleeders, either sew them up individually or sew muscles over them. I think I’ll do the latter.”

Done – A half hour later it was done. Only a slight oozing of blood could be detected. He spread an antibiotic cream over the entire area of the stump and covered it with gauze. Then he applied more gauze generously spread with Vaseline. Two Ace bandages secured the packing. He studied the book for a few minutes, then attached two traction strips to the skin above the wound using wide adhesive tape. “That’s it!” he exclaimed. “We’re done!” Cheryl breathed a deep sigh of relief and sat down slowly in the nearest chair. Dave called Nick and Anne, directed them as to how to apply the traction ropes after they had moved Jack to a cot in the living room. Then he too sat down. It had taken nearly two and a half hours. Cheryl was drained. Dave was nearly so, and both were covered with blood. The foot and mangled leg lay in the pail below them.

“What are we going to do with that?” she asked. “Well have to bury it in the back field,” he answered. “It will be hard digging in the frozen ground, but we will have to do it.” "Do you think he’ll make it?” she asked “Yes I do. He’s young and strong. The worst part of the whole thing in that this operation has made a helluva hole in the medical supplies. That was just about all the Xylocaine and a good part of a lot of other stuff. We are going to have to find some more. This won’t be the last accident in town. You can bet on that.”

2. This story was posted on an internet preparedness forum and is a reflection on what might be possible in a major long term collapse. (reproduced with the authors permission).

The Apprentice

Alex was tired. It had been a long 10 years. She needed help. It made her residency seem like a walk in the park – 80 hour weeks for 4 years – she thought that had been tough. What she would give now to go back to it, she wouldn’t curse the hours or call what she felt then exhaustion. She was exhausted now. 10

years. 10 years since everything had fallen apart. 10 years as the only doctor in the area – the only medical care in the area. 10 years of constantly being on call and available. She didn't know of any other doctors that had survived. She heard rumors that a community to the north had a nurse and most of the communities had healers – with varying levels of skill, training, and quality – she had heard a few frightening stories. Everyone within riding distance still came to her. She didn't mind. But she was tired

When it happened, New Zealand had been relatively spared. The main impact had been in the North Atlantic. North America and most of Europe had been decimated. Small hits in the north Pacific had resulted in the massive waves, which had travelled south. They had tried various things to knock it off course, but all that they achieved was to blow it into smaller pieces – it had all seemed like the plot of some bad B-grade '90s movie. She had been staying at her sister's farm, by chance more than anything. Her husband was away at a conference in Australia and she had taken the opportunity to spend some time with her sister. The farm was inland at 1500m above sea level. Although only 20 kilometers from the coast, the rapid climb in altitude had spared the valley the farm was located in. The watermark for the wave was 10kms away and 700m lower down – and still even after 10 years the line of destruction was clear. The secondary growth was well established, but the magnitude of what had occurred had scarred the land.

The initial wave had killed nearly 2 million. Most of the population of New Zealand had lived on the coast. That was where all the major cities were located. Despite the warnings, many hadn't evacuated the coastal areas and some of those who had evacuated under-estimated the size of the wave – moving only to the foot hills several hundred meters above the see level. Many had also gone to watch – believing that a few 100 meters of altitude would be enough to save them. More still had believed the "government-line" that a solution was at hand and it was not going to be a problem. No one expected a 50-metre wall of water – that was bad enough, but many died from the enormous surge wave when it hit the coast that went kilometers inland and 800m high into the hills.

Fortunately, both islands of New Zealand were dominated by mountain ranges and plateaus. It allowed many people to survive by a quirk of geography – some inland towns and their people were almost untouched by the wave. Their salvation was only temporary.

The first quakes began with the strike, even before the wave had rushed south from the North Pacific, the tremors had started. Everyone knew that all the tectonic plates were connected, but again no one for a moment thought that all would move with the strike. The small tremors evolved to larger ones – the largest that struck New Zealand would have measured 8.2 on the Richter scale – but by then the measuring equipment and the men who knew how to read them were long gone – all the survivors knew was that it was a huge earthquake. A further 500,000 died in the quakes.

The land strikes in the Northern hemisphere threw up millions of tons of dust, debris, and water into the atmosphere. For months, daylight became twilight and the rain torrential – fortunately the southern skies were less heavily contaminated – rather than the constant twilight of the northern hemisphere it was more just overcast with little clear sunlight and much muddy rain. Over the following year nearly another million died from hunger and disease. New Zealand's 4 million population was decimated to 50,000 or so - scattered all around the islands in isolated pockets.

The valley where her sister's farm was located, while home to 15 families, was nearly deserted. Many had gone further inland – while others had gone down to the coast to "watch" the wave. Early on

another family had joined them from higher up the valley. Their home had collapsed under the earthquakes. While the farm had suffered some minor damage - structurally it made it through the quakes ok. Immediately after the strike, they had taken stock. They were on a farm – from a practical point of view they were in a good position to start from. This wasn't something they had ever planned for. Just before the strike they had gone into town to "stock-up", and had bought their usual month's worth of staples. Sue, her sister, had thrown some extra rice and flour in "just in case", because of all the hype in the media, but like everyone else, she hadn't really expected to need it.

Immediately following the strike, Daniel had bought the best livestock down to the home paddocks – 50 sheep and a couple of rams, 10 cows and a bull. For the remainder, he then opened the gates on most of the farms in the valley to allow the livestock to get out – it was clear that the numbers of survivors in the area was limited and that they were only going to be farming for themselves for a while – if he left the animals in their paddocks they were going to eventually starve with winter coming up and with the limited manpower they just couldn't manage that many. At least with freedom to graze a few more might survive - and potentially provide some hunting targets if required in the future.

Alex had taken stock of the medical side of things - she had her "black" bag in the boot of her car – the one she kept ready for the occasional motor crash - or for treating the odd relative – it had a few bits and pieces in it – a stethoscope, bandages and dressings, pain medicine, some antibiotics and some intravenous fluids. It wasn't much but it was a start. The medicine cabinet was well stocked – the farm was 2 hours from nearest doctor or chemist – so her sister had always kept it well stocked –bandaids, antiseptic, Tylenol – by the box and a few other pills and potions – including several courses of antibiotics. When they had started scavenging the local abandoned farms for anything useful she had made lists of medical supplies and drug names and they had checked bathrooms and bedside cabinets for anything useful. Dredging through the cupboards she had come up with several half-finished courses of antibiotics – many of the same type enabling her to obtain quite a few complete courses of a few of the common ones, assorted heart and blood pressure meds, and numerous simple analgesics. Another immensely valuable thing had only been discovered by accident, Daniel's father had an enormous library of old books, when he had died they had been all boxed up and he had been waiting to sort through them. During the rains and storms that followed for months after the strike he did. There were several books on herbs, but most useful was a book entitled "Medicinal Plants and Herbs of New Zealand", it had been published nearly 50 years earlier, in the late 50's, and while some of the science may have been a little suspect – it was a fantastic resource and collected the experiences of the indigenous Maori people as well as European science from the first half of last century. The farm had been near the bottom of a long valley; the county road ran the length of it, dropping steeply down into the next valley from the top. Soon after they had secured the top road where it dropped down into the next valley over with some simple tree felling – the countryside was very steep with the winding road cut into the hill. With the road blocked, it essentially made access into the top of the valley very difficult.

It had been hard to decide how paranoid to be in terms of being prepared to defend themselves – they had all seen the rioting and violence on the TV that had immediately preceded the strike. They also knew that many people were dead. In the end paranoia prevailed. The farm paddocks were already surrounded by 6-foot high deer fences - initially they extended and reinforced the fences around the homestead and the immediately adjacent paddocks - strengthening the posts and adding extra intertwined barbed wire. Over time the homestead itself was surrounded by a sturdy wooden fence. To begin with there had just been the 10 of them – Alex, her sister and her husband, their two children, and the farm worker and the family from up the road – two adults and their children. The first few years had been very hard. The first year had been literally meat and potatoes. Seed for stock feed was suddenly

seed for human feed. But their saving grace was the fact that they knew how to farm. Eventually they got staples established and some of the cows in milk. They had never truly faced starvation but they had come close in those first few years. At what point the farm had become a proper village or community was a blur – it just evolved over several years. It had just been the house and the barn - originally. Now the farmhouse was the center of the community. The home paddock was now full of small cottages, and on the old tennis court had been built a communal hall. The two-room clinic was built between the homestead and the hall. In the paddocks down the hill slightly, by the road, was the market square - with the permanent buildings of the "hotel" and the blacksmith, with the lean-to's that the various traders occupied as they
came and went. About half the land was in crop with the other half carrying a mixture of cattle and sheep. From ten people, it had grown to nearly 40 in 7 families with another 10 families living further up the valley. Each family had a vote on the council and decisions were carried with a two-thirds majority. Danie, her sister's husband was the community leader by default. Immediately following the disaster he had been the organiser. Without him, they probably wouldn't have survived. Without him, the community would never have evolved as it had. No one had thought to challenge him - the combination of the family council and Daniel's leadership seemed to work well. Over time various trades had emerged. It was a rural community to start with - so there was plenty of general farming knowledge around. One guy had been a mechanic and panel beater who also shoed horses on the side - it was a natural progression for his metal working skills to evolve into full blacksmithing. Likewise the homebrew enthusiast evolved into community brewer, publican, and bartering coordinator. Most just farmed.

There was limited technology - they had small amounts of wind and water-generated power - but with time, most of the electrical equipment was breaking down - even with their best efforts they wouldn't last much longer - they had long since run out of light bulbs. They still had a couple of working diesel tractors, the diesel was very limited, but they could still use them for the very heavy work - but again they were working very hard at alternatives.

Medicine had changed. Early on it had been ok. They had a good supply of the basics. Ninety percent of medicine was just educated common sense and didn't need to be anything high tech - and they had been lucky. Deep down they had all accepted that there was a limit and one day a simple thing was going to kill someone- it distressed Alex the amount of faith the others placed in her. There had been a few near misses and a very messy and unpleasant stillbirth - but she had coped and dealt with things. Things now were getting worse. She still had several drugs left - a few antibiotics, some Tylenol and a few other bits and pieces. She had long ago run out of commercial IV fluids and was experimenting with batches of homemade normal saline. They had also been making their own ethanol and producing small amounts of heroin. She was also starting to use many more botanical therapies - herbs and some of the local plants - she wasn't yet convinced how effective they were - but she had been pleasantly surprised on several occasions. But they were also running out of other consumables - gauze, sutures, and needles - fortunately ingenuity and a DIY attitude went further here than it did with the medications. There was no such thing as "single use", if they could clean it and/or re-sharpen it - it was used again. So, ten years on, things were vastly different - but human nature being what it was they had adapted. Back to an agricultural society - but a hybrid society with a knowledge of technology but only a limited ability to deliver it - with high hopes for the future.

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Then the idea had come to her, in her tiredness and sense of being overwhelmed it had come to her. The blacksmith – he had been an auto mechanic who shoed horses on the side – but he was the blacksmith

now. He was always working with his 14-year-old son. His son was rapidly picking up the skills, in some ways more adaptable and innovative than his father, but essentially, he was the blacksmith's apprentice. Why couldn't she take an apprentice? That was how medicine was taught up until a few hundred years ago. It made sense – there were no medical schools. She was amazed she hadn't thought of it sooner. Her thoughts were interrupted by knocking on the clinic door. She got up from her seat and opened the door. She was greeted by the earnest looking 11-year-old son of one of the farmers up the top of the valley. "Doc, can you please come quickly, mum's sick. Dad thinks she dying". He looked scared. She grabbed her backpack and followed him out the door.

Alex hurried outside to her bike. It wasn't fancy, just a standard mountain bike. Since the petrol had corrupted several years ago, the few bikes the village had were now worth their weight in gold. The Hanson boy, who had rode down to get her, was up ahead on his gelding. She wasn't as fast on her bike as he was on his horse and his frustration was starting to show. It was only 8 km's to the top of the valley, but the Hanson farm was near the top. It was a ride she usually enjoyed, but on this occasion she could feel her anxiety levels rising. Any time she attended an emergency or one was bought to the clinic she had the same feeling of anxiety. It was the one she had had all of her working life - but now the anxiety was amplified by the knowledge that even though she had developed the skills to work without the fancy diagnostic tests and she prided herself on her diagnostic accuracy - the right diagnosis meant little without the supplies to manage the problem. After what seemed like an eternity to her, but what was in reality only 15 minutes, she reached the farm. It was much like the others that were in the valley away from the main settlement: A pre-crash farmhouse – but now with reinforced fences and barricades and heavy window shutters.

There had only been a few attacks in the valley and none against the main settlement – but there was the constant awareness that there were still the occasional loner or small gang that survived by robbery. However for the most part the travelling bandits had burnt themselves out and were now either dead or had found that community farming was the only sustainable long-term option. They had heard stories of several hostile settlements, which, were based around some the early roving bands – and that while they had settled down they were still unpleasant neighbours to have, not thinking twice about stealing crops and livestock. But by the nature of the catastrophe the population was fortunately widely spread, and overtime there was little competition for resources and there had been plenty of supplies to forage.

In the first few years it had been much worse – any stranger was a major risk – the majority had been looking for trouble. Access to the valley from the high end was very difficult and they had destroyed the single road access making it almost impossible, except for the very determined person on foot – and even then the almost invisible paths and steep hillsides and cliffs made passage very difficult. The main access was at the bottom of the valley and was across a bridge over the confluence of three rivers from neighboring valleys and their own, which was deep and fast moving. They had had control of the bridge from the beginning. So while early on there had been several attacks by small groups on foot, they had never had to deal with the motorized attacks they had heard about from some of the other nearby communities.

She was shown into the house by Ralph Hanson; it only took a look from the bedroom door to tell that Sue was pretty sick. Alex turned back to the boy and told him to go back down to the village and get someone to bring up a cart. She turned back to Sue. She was white as a ghost and lying on the bed, and in obvious pain. She knelt by the bed and simultaneously began both reassuring the sick woman and taking a history. The blocks rapidly fell into place - Sue had missed her period 2 weeks ago and had just been building up the courage to tell her husband and boys. She had developed colicky abdominal pain

yesterday and this morning it had got much worse. When she had got out of bed she had fainted. Her hands felt cold to touch and she had a rapid thready pulse at 125, the lower half of her belly was rigid and extremely tender. Alex had no fancy tests to confirm the diagnosis, but the story and Sue's current condition where enough - she had an ectopic pregnancy and was probably going to die. Alex felt a flutter of panic. She didn't really know where to start, Sue needed surgery, and that wasn't an option. "What should she do first", she thought sitting holding Sue's hand as her distressed husband looked on. "Pain relief," she thought – at least I can make her more comfortable. She drew a iv cannula from her bag - it wasn't a cannula - it was the needle from an old cannula - bleached, boiled and sharpened - as sterile as possible - gone were the plastic cannulas - she was back to leaving the metal needles in veins. Sue was lean and muscular and despite her blood loss, several veins popped up as she applied the tourniquet and Alex easily cannulated her. She reached into her bag and pulled out a small jar of coarse brown crystals, a bottle of sterile water, a 10 ml glass syringe, and needles and began the process of making up some heroin.

The Heroin had been her first do-it-yourself drug. The opium poppy had been surprisingly common in the local gardens; most people didn't recognise them for what they were. She had a basic idea of the process from her university chemistry and combined with a bit of street knowledge - she had had a go. There had been a heroin shortage in New Zealand in the late '80s and the local addicts had resorted to robbing old ladies gardens. She had been at medical school at the time, and she remembered talking in clinical chemistry about how they had been extracting the heroin - it was amazingly easy. So now she had a small jar a granular black powder - it probably wasn't that pure – mostly heroin – but with a small mix of the assorted other opiates and alkaloids found in the poppy. On the few occasions she had used it, it had been very effective - a little trial and error with the dosing - but effective. The main problem now was sterility and removing all the insoluble rubbish - she had adopted basically the same techniques the addicts had used – but hopefully slightly more sterile - dissolve it in distilled water, filter it as best she could – she had a small supply of cigarette filter paper she had salvaged for the purpose, and then heated it to sterilize it. Not perfect by any means, but like everything else in her world now – near enough frequently had to be good enough. She slowly administered 2mls of the solution into the IV. The dose was an educated guess from her previous experiences. Her biggest worry was that the heroin would drop Sue's blood pressure more. But over the next few minutes, her moaning settled and she seemed more comfortable. The next priority was getting some fluid into Sue. She didn't have any IV fluids with her. There was some down in the clinic, but they were too cumbersome to cart around in her medical backpack. The boy reappeared, in a surprisingly short period of time, with one of the farmers from the village and his horse and cart (really a cut down car with a removed engine and a substituted horse) and they half carried and half walked Sue to the back bed of the cart. They moved off slowly down the valley in the cart, with Sue moaning softly as they moved over the broken tar sealed road, Alex again was trying to think what to do next. She had thought about operations many times before. On each occasion trying to decide how much she would be able to do. Always she arrived at the same conclusion – that while setting fractures and perhaps performing an amputation might be possible, she wasn't ever going to be able to perform open abdominal surgery – and anyone who needed it was going to die. But now faced with Sue Hanson, lying there in front of her, it didn't seem so black and white anymore. She turned to both Sue and Ralph. "If I don't do anything, your going to die", she said, trying unsuccessfully not to sound too blunt, "I can try and operate, but the chances of me being successful are low", she went on to explain the problems with anaesthesia and infections. She sat back and waited. Sue was sobbing quietly. She looked up at Alex and said "please try".

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With some help she had positioned Sue on the operating table, again it wasn't really an operating table, it was simply her usual examination couch – essentially just a fancy wooden trestle table that had been made for her - which had been pulled out from the wall to the middle of the room and scrubbed down with homebrew alcohol. The first 500mls of normal saline had nearly run through, and Sue's heart rate had come down and the volume of her pulse seemed stronger. Alex took it down and started the 2nd bottle – she only had one more litre. Although this didn't bother her overly, while Sue was still bleeding from her ruptured ectopic she didn't want to push her blood pressure up anyway – it would just pop what clot might have formed and encourage more bleeding – more the moment, as long as she had a radial pulse and was awake – that was enough – she didn't need litres of fluid – she needed an operation.

Like the heroin, the normal saline was a bit hit and misses. The theory was easy - 9gm of salt in 1 litre of water = normal saline. The problem had been how to manufacture it and keep it sterile using a pretty rudimentary set-up. Despite the devastating nature of the "strike", they hadn't been completely driven back to the Stone Age, and while she didn't have access to proper laboratory equipment, early on in their foraging, they had striped the county school of much of its science equipment. This had meant that she had a good number of flasks, beakers, test tubes, and bungs and a small glass condensing coil – most useful of all was an old-style hanging scale, with weights for 1-100gms. This motley collection of equipment had enabled her to produce the heroin
and produce small batches of intravenous fluids.

The basic process was simple. Alex had enlisted Tom, the community brewer – he had over the years established a successful little beer brewery and a still for making various spirits – on which he also made her high proof medical alcohol. His knowledge of brewing and distilling had been and still was vital in her primitive pharmaceutical production. They had first double distilled water to try and get rid of as many impurities as possible. To this they had added the carefully measured out salt
– almost certainly not 100% Sodium Chloride – but hopefully pure. They had a dozen 500ml flasks, which had rubber bungs. Having scrubbed and sterilized the flasks, using the same method they were using for canning, they were filled with the filtered saline solution and the rubber bung inserted. Then they had used the large pressure cooker they had for canning to heat the bottles to 122 degrees C for 30 minutes. To actually use the fluid she had a special bung, which had a hole in the middle, which fitted the IV tubing perfectly. She boiled that, switched it over with the flask's solid bung, and connected the tubing – so far it worked.

Alex was happy that when manufactured the saline was sterile, she didn't really know how long that sterility was going to last. Since the actual production wasn't that arduous and only took a couple of hours, she had decided to err on the side of caution and had determined a shelf life of 3 months on it. Again, resorting to primitive science, she had tried some basic tests to check the sterility – at one, three and six months. This had involved injecting 10 mls of the saline into a poor unsuspecting bunny from the communities "rabbit ranch" and seeing what happened – even at six months' post production the rabbit didn't seem to suffer any ill effects from its run-in with the home-made iv fluids – not a 100% fool-proof purity test – but better than nothing. This was only the second time she had used the saline "for real". Her and one of the farmers had also experimented on one of the farm dogs to try and get a feel for the dosing for the heroin – they had started off injecting small amounts – so increasing it – seeing how much it took to make the dog drowsy and then how much it took to depress its breathing. From these experiments, she worked backwards to come up with a rough grams/kg dose – but she had also learned that each batch of heroin was slightly different, so the element of trial and error was still there. Alex

found it distasteful to be experimenting with doses and sterility on animals – but like all the survivors, she was a realist about what had to be done to survive. So here she was, standing in her clinic contemplating what even before the impact had
been major surgery – and she was both surgeon and anaesthetist!

For the second time, today she was cursing her own stupidity for not even thinking of an apprentice before now. That wasn't quite true. She had enlisted some help. Kate wasn't an apprentice, she was a 68-year-old, old-school farmer's wife - she could stand the sight of blood and had helped two of her daughters have homebirths, back before the Impact – back before it became "fashionable" again, now there was no alternative - so she at least had a few medical clues and didn't faint at the sight of blood. She had helped her on a few occasions before and Alex had briefed her about what she was going to do, so she had a rough idea of what she was going to need to do to help. Alex injected another couple of mls of heroin; she was still worried about giving her too much and dropping her blood pressure to her boots. She looked at the fluid bottle, about 1/2 had run through. She turned to her instruments - they were a real mix (like everything else) – she had one good set of quality suture instruments she had foraged early on – a needle holder, two forceps, a pair of clips and some scissors - and a average quality university science dissection kit, the most handy item being a reusable scalpel - which she had just sharpened - before having boiled the whole lot for 20 minutes. She had also boiled another pot of water to use as sterile irrigation fluid. She started to scrub-up. She had no gloves, but catching a viral infection from a patient was really the least of her problems anyway – what choice did she have. She checked her hands and fortunately had no open cuts or grazes – although again it mattered little – she had to do the surgery and while it was good she had no open wounds she would have continued anyway. So with the coarse, gritty homemade soap she started the ritualistic washing. Wet, lather, scrub, rinse, repeat – hands and forearms – she had always questioned the merits of scrubbing for 5 minutes when you were going to be wearing 2 layers of latex gloves, but now, under these circumstances she understood clearly the origin of these old surgical rituals – with no gloves and very limited antibiotics, she wanted to reduce as much as she could any bugs living on her hands. When she had finished washing her hands she had Kate pour alcohol over them, and she allowed it to evaporate off as she pondered what she was about to do – she pushed all her thoughts of self-doubt to the side and took a deep breath.

Now Alex was ready to start. She laid out all the instruments, syringes and sutures – almost looks like a proper operating theatre she thought to herself with a smile. Her first task was to prep the skin on Sue's abdomen. She picked up a piece of clean, if not sterile, decades old gauze with some sterile salad tongs soaked it in the dish of homebrewed alcohol. She then started to clean – in an expanding circle, starting first where she was going to make the first cut and expanding out in wet overlapping circles. The she picked up the 20ml syringe with the last of her 1% lignocaine and slowly infiltrated it into the area she intended to cut. Having infiltrated the local, she again asked Sue how she was feeling, this time the only response was an incoherent groan. She picked up the scalpel; she made a small 2-inch cut, 1-inch above her pubic bone. There was no response from the top end of the table. As she cut deeper, she infiltrated more of the local anaesthetic. She cut through the fat down onto the rectus sheath; she made a small cut in the sheath and poked a finger through. Sue moaned softly. She asked Kate to give some more heroin and she injected some more local anaesthetic. After waiting another couple of minutes, she stretched the rectus sheath and the muscles opening a small 1 1/2 in gap - through the transparent peritoneum. Beneath she could see the blue tinge that signified blood. At least she had got the diagnosis right.

She asked Kate to start the suction (a old tire pump working in reverse and a couple of sealed up canning jars connected in series – connected to some plastic tubing – which in turn was connected to a hopefully sterile suction handle – which in its previous life had been a cake decorating implement!) and she poked

her finger through the peritoneum. This was the most stimulating part of the operation, and as expected Sue moaned and started to pull her legs up. Alex leaned on to her legs, pushing them down and spoke meaningless platitudes to her. Despite the movement, she was still stoned on the heroin, and the local was helping a lot. Having sucked most of the blood out she fished around for a fallopian tube with her index finger - she pulled the left one up into the wound - that was the side the pain had started on, wasn't it? There distending the end of the tube was the ectopic pregnancy purple and congested looking - oozing heavily. She picked up her gut ties, and looped first one and then another around the base of the ectopic and pulled them tight. The bleeding stopped and the ectopic and the tube end became pale, she picked up the small sharp scissors and cut along above both her ties. "How things change", she thought to herself. The goal before was to preserve fertility at all cost - now as she cut of the now tied-off end of the tube, she was just hoping Sue would survive the night. With the bleeding controlled, she poked the fallopian tube back inside and reached for the now-cooling pot of boiled water- she added a splash of povidine to it. Using the small sterile glass jug, she ladled the water into the wound, sloshing it around washing out blood clots and hopefully any bugs, which had found their way in. She suctioned the water out and began to close the rectus sheath with her last 2/0 nylon suture and finished the skin with some 3/0 - at least she had a couple more of those – fortunately she had a large supply of fishing nylon and some of that was fine - that would do in a pinch - but she wasn't quite resorting to that yet.

She had given Sue a gram of ten-year-old amoxicillin tablets just before sedating her and she would give her some more when she woke up, the limited IV antibiotics they had foraged had been used up years ago. She still had a small stash of several types of antibiotic tablets - but they were all more than 10 years old and only God knew their potency. Again, with some extra help, they moved Sue over onto one of the beds in the small two-bed ward. That was the last of the local anaesthetic. If she had to do a major procedure again she had nothing but homebrew alcohol. She had thought before about manufacturing Ether but had shelved it in the "too hard" basket – she would have to think about it again. Alex sat looking at Sue – she felt exhausted and worried. Worried that infection would set in, worried that everything was slowly running out and that even ingenuity and back yard chemistry can only go so far.

Chapter 26: Reference Books

No austere medical chest is complete without a good reference library to back it up. Knowledge tends to fade with time and non-use, and there will always be situations arise that require looking up a procedure, a pictorial reference, a protocol or dosing information. Then there are future caregivers to think of, who will not have the benefit of our modern system of education.

Professional healthcare providers take regular continuing education to not only stay up with the latest techniques, but also to aid in retaining skills not often practiced. Having good reference books on hand may be important during times when the education system is no longer working or accessible. When a nonprofessional, or even an experienced healthcare worker, is faced with a situation that calls for new knowledge or skills, having competent references may be critical.

Since the last edition many new books have been published which further develop the austere and/or survival/disaster medicine field, while others are no longer in print. Keeping this in mind it is the intention of the authors to recommend the most up-to-date and potentially useful references available at the time of this publication. Some will be very recent, while others may be older but remain very useful if not in some instances even essential.

In **Chapter 22 - Primitive Medicine** – the point is made:

"*Knowledge cannot be undervalued. While at first thought, it may appear that the loss of modern technology and medication will place medical care back in to the dark ages*, *it is important not to forget that the knowledge underpinning modern medicine is still there*."

And to add further emphasis to the point:

"*In a long-term disaster, it is vital that this knowledge is preserved. For this reason, it is extremely important that you have a comprehensive medical library to begin with and that there is a priority to preserve the knowledge the books contain. It is also very important that the knowledge is passed on*."

It is this spirit that this chapter is offered.

IMPORTANT POINT FOR CONSIDERATION

Some of the references listed are available only in pdf format rather than print editions. While having the ability to store thousands of pages of references in a device small enough to slip into your pocket is admirable in a long-term power-out situation only hard copy versions – books – are likely to be available. Computers and electronic readers require electricity. Give strong consideration to making an actual print copy for your shelf of those manuals you may consider essential to your situation. Some commercial printers such as Staples or Office Depot will print a single bound copy for personal use from a portable storage drive you provide containing the material in electronic format.

This chapter will be divided into six sections.

The very first is simple, aimed at those who have no medical skills or training other than basic first aid: it is for those who **are Just Getting Started**.

Then we have the **Primary References** intended for those with at least EMT-level and above skills and/or training.

Following this is a section of **Valuable Additions** that will build on the Primary category.

Next, we have the **Medical Professionals** recommendations, intended for current practitioners (doctors, nurses, physician assistants and nurse practitioners, veterinarians, dentists and others) who may find themselves in need of additional resources to effectively function outside of their normal area of practice.

The fifth and final section is **Uncategorized.** It contains a list of useful references that may be considered depending on your goals, your level of medical training and practice, and additional areas that may need to be considered such as veterinary medicine.

Finally, we have a section devoted to animal husbandry and veterinary medicine references .

Occasionally, you will notice two or more recommendations that seem to closely parallel each other. This is because the ability to access one versus another, or the cost of acquiring them, may be more of a deciding factor for some buyers rather than the information they contain.

Some books are listed in other sections as well. This is intentional, as some references are so valuable across the spectrum of providers that they should not be overlooked.

1. I Am Just Getting Started

This category represents a bare bones basic austere medicine library for the untrained. None of these books will teach you to perform field surgery or perform a physician-level exam. But taken together these books will give even a complete novice a basis for providing medical care above that of a simple first aid level. If you already have medical training to at least the Basic EMT level you may wish to skip to the next section and concentrate your efforts there, where you will find references covering the same material and more, though from the assumption that you already have the basics covered.

Where There Is No Doctor by David Werner with Carol Thuman and Jane Maxwell. Hesperian Foundation. Latest edition circa 2014. List price: $27.00
https://store.hesperian.org/prod/Where_There_Is_No_Doctor.html

It has been long-considered the definitive "bible" of third world medicine and certainly the one by which all others are measured. The Third World environment mimics in many ways the post-disaster level of development many envision should it ever come to pass. The book offers significantly useful information for handling everyday medical problems by unskilled caregivers with minimal access to resources. Generously updated. Also available in Spanish and Portuguese.

Where There Is No Dentist by Murray Dickson. Hesperian Foundation. ISBN: 0-942364-05-8 softcover, 188 pp, B & W and line drawing illustrations. Written 1985, last updated in 2012 with a section on Atraumatic Restorative Technique (ART), which details a way of making permanent cavity fillings without the use of a dental drill. List price: $17.00
https://store.hesperian.org/prod/Where_There_Is_No_Dentist.html
The only book of its kind, intended for the untrained dental practitioner. How to care for the gums, extract, fill or repair teeth, manufacture your own basic dental instruments, and more.
The above two books are sometimes offered as a set for a cost savings.

Where There Is No Psychiatrist: A Mental Health Care Manual by Vikram Patel. Publisher: Royal College of Psychiatrists (2003) ISBN 1-901242-75-7 Softcover, 266 pages. List price: approx. $12.00
A practical manual for mental health care for the community health worker regardless of level of training. Mental health care will be at a premium during times of significant stress. Though the book often suggests getting the person to an actual doctor for prescription medication it is the only book available than can guide the austere care worker through the process of Cognitive Therapy, which is a widely used form of counseling, used either alongside medication or as a stand-alone therapy.

A Book for Midwives by Susan Klein. Published by The Hesperian Foundation. Copyright March 2013. Soft bound, 527 pages with thousands of simple illustrations. ISBN 0942364236 List price $32.00
For the untrained healthcare provider this is one of the best pre-natal, birthing and post-natal books available. Written for remote locations where access to trained medical aid is impractical or non-existent.
https://store.hesperian.org/prod/A_Book_for_Midwives.html

Pocket Companion for Physical Examination and Health Assessment, 7th Edition By Carolyn Jarvis, MSN, APN, CNP. W. B. Saunders, ISBN:0721697747 Copyright February 2015. Softcover, List price $56.95, 304 pp., Approx. 250 color photos and illustrations.
Frequently the weakest area for any untrained medical care provider will be the ability to perform a qualified health exam. Having a decent reference to guide you through the more unfamiliar aspects could prove invaluable. Basic and to the point, it is still comprehensive without being overwhelming. For someone without formal medical training this is probably the easiest guide to use.

2. Primary References

This section makes recommendations for references that will likely prove to be the most useful for trained or educated healthcare workers who are seeking to expand their skills beyond those of the average non-doctor healthcare worker. There is no order of importance to the list. Rather the reader

should determine for themselves what might need their most pressing needs, and establish their own priorities for acquiring those references that they find desirable.

Publishers' prices are listed for each reference. Bear in mind that many of these can be found as used copies for much lower prices through on-line sellers such as amazon.com and barnesandnobleinc.com Updated editions are not always better. Sometimes the updates consist only of an added chapter that may be of little importance to the austere medical care provider. Do your own research and then choose accordingly. Previous editions often sell at a significant discount.
Sellers who specialize in used books include abebooks.com, powells.com and bookfinder.com.
Where appropriate, direct links to downloadable versions (pdf documents) are listed. In a few cases this may be the only version available.

Wilderness and Survival Medicine 2nd Edition by Chris Breen, RGN, Paramedic and Craig Ellis, M.D. Copyright 2013, Amazon Digital Services LLC (also printed in the UK), softcover, 542 pages. Black and white photos and detailed line drawings. ASIN: B00GM108MG $34.22 on Amazon. Kindle edition available.
Updated from the first edition of 2011 and written by two authors with a wealth of experience providing care in unconventional environments. It is a first-stop reference that will provide needed information for initial treatment and further consideration. It is divided between actual how-to and guidelines for further study. It is written in British rather than American English and some terms used (Paracetamol rather than Tylenol, for instance) may take some getting used to, but anyone with a high school education should find it easily understandable. The information contained within it will be useful for most users seeking basic information on how to treat, how to assess, and what to consider. It is written for an audience with a modicum of medical training, but is understandable by those who are new to providing more than very basic first aid.

Emergency Dentistry Handbook: Providing Dental Care in Disaster Areas, Combat Zones and Other Austere Environments by Met Clark, EMT-P. Paladin Press. Copyright 2011, softcover. 90 pages with clear drawings and black and white picture illustrations. ISBN-13: 978-1610040440 $11.00 on Amazon.com
This book packs a lot between the covers and provides a good deal of information, including antibiotic, analgesic and anesthetic choices. It details 3 levels of field dental kits and offers practical advice on using up-to-date glass ionomers for filling material. An outstanding reference for both the non-dental medical practitioner and those seeking to provide more than simple dental care.
For basic, use-what-is-at-hand dentistry see Where There Is No Dentist in the I'm Just Getting Started section.

Pharmacology Made Incredibly Easy, 4th Edition by Gersh, Heimgartner, Rebar and Willis. Published by Wolters Kluwr Health in 2017. Softcover, 746 pages. ISBN 9781496326324 List Price $50.99 through Barnes and Noble
An outstanding reference for care givers who do not have formal pharmaceutical training beyond basic emergency medications. Paramedics, nurses and even many specialist doctors might benefit from this reference as it covers medications by class through a total of 15 chapters. Chapters include Pain Medications, Respiratory Drugs, Gastrointestinal and Psychotropic Drugs and general medication safety. Many useful references are also found, such as the difference between an allergic response versus sensitivity or overdose versus iatrogenic (unfavorable) effects.

The Sanford Guide to Antimicrobial Therapy 47th Edition Published 2017 by Antimicrobial Therapy, Inc. Softcover, 257 pages, measures 5" x 7". ISBN 9781944272005 List price $24.99
An indispensable guide to matching the right antimicrobial (antibiotic) to the right infection, including suggested duration of therapy and dosage adjustments for obese patients. It also contains treatments options for multi-drug resistant infections.
Non-illustrated but does contain an 8-age colored graph of Antibacterial and Antiviral Spectra (effectiveness) for various medications.
Required caveat: due to the small size of the book itself it is suggested that a reading magnifier be available for anyone with less than perfect vision due to the small print.

The Concise Book of Muscles, 2nd Edition by Chris Jarmey and John Sharkey. Published by North Atlantic Books (USA), Bell and Bain Limited (UK) in August 2008. ISBN 9781623170202 (USA) 9781905367627 (UK). Softcover, 311 pages. 8.5 x 11 inches for easy reading. List price $32.95 USD, $41.95 CA
6-color illustrations are very clear and focused and limited to one muscle per page. Each page lists the basic functional movement, common problems when the muscle is chronically tight/shortened (spastic), the action of each, and the central nerve that serves each muscle. The print is a very easy to read 12-point type.
Potentially an invaluable tool for anyone who is not very familiar with human muscle anatomy.

The Basics of Wound Care by Nadine B. Semer MD, FACS Published by Global HELP. Copyright 2003. ISBN-13 #978-1-60189-011-5 Available exclusively in PDF format. 16 pages, 8.5" x 11", Four-Color, English
http://global-help.org/publications/books/help_basicwoundcare.pdf
A well worth having basic wound care guide. Basic principles, very well illustrated and easy to follow. Consider printing a copy for your medical chest.

Wounds and Lacerations: Emergency Care and Closure, 4th Edition by Alexander T. Trott, M.D. Published by Mosby-Yearbook April 2012, hardcover, 336 pages, 300+ illustrations. ISBN 0323074189. List price $65.73.
The definitive wound closure manual for non-surgeons. Easy to understand language and format that will not leave a layperson reeling but which a trained physician can easily relate to as well. More than 300 line drawings and photographs. Assessment, irrigation, administration of local anesthesia, foreign body removal, and just as importantly when NOT to close. MRSA wound guidelines also provided in this edition.

Nurse's Illustrated Handbook of Home Health Procedures. Softbound, 593 pages. Springhouse Corporation. Copyright 1999 ISBN 0-87434-960-5 No update available. List price $33.05. Used copies generally start at under $10.00.
Intended for nurses providing home health care this book represents a very valuable resource for the remote area/post-disaster care provider. It proceeds from one basic premise: that the care giver is relatively new to or even unschooled in basic care procedures required during sub-acute, long-term or recovery health care management.

Clinical Nursing Skills and Techniques, Revised Reprint by Ann Griff in Perry & Patricia Potter. Mosby, 5th edition, 2003. Softbound, 1,360 pages. ISBN: 032302601X List: $71.95
Nursing skills from basic to advanced, intended for first year nursing students. Pictorial how-to. If you happen to be a nurse who finds themselves thrust into a role you aren't familiar with, you may find this book invaluable. Likewise any other medical care-giver who doesn't normally perform the wealth of

procedures contained within this reference. Later editions are available but tend to be oriented more towards high-tech medicine.

The Complete Idiot's Guide to Dangerous Diseases and Epidemics by David Perlin, Ph.D., and Ann Cohen Softcover, 315 pages. Pearson Education Inc. Copyright 2002 ISBN 0-02-864359-3 $18.95 USD
Light-hearted while authoritarian. Panic/don't panic information. A very useful guide to rapid decision making without getting bogged down by details. A much better than average starting point when seeking quick information about specific infectious diseases. As of 2017 it appears to be out-of-print but used copies are readily available through several sources including Barnes and Noble on-line.

The Survival Nurse: Running An Emergency Nursing Station Under Adverse Conditions by Ragnar Benson. Paladin Press, copyright 2000. $19.00 Softbound Paladin Press ISBN 1-58160-075-5
The only general reference available to date on running a remote nursing station. Basic considerations for feeding, sheltering, bedding and providing general nursing care in an austere environment. It assumes that first world resources are not available.

Respiratory Care Made Incredibly Easy! / Edition 1 Published April 2004 by Lippincott, Williams and Wilkins. Softcover, 352 pages. ISBN-10: 1582553351 List price $37.17 from Barnes and Noble.
Covers assessment, treatments, infection and inflammation, traumatic injuries, respiratory emergencies and more. Geared more towards in-hospital healthcare workers yet offers some invaluable insights and tools for basic respiratory care as well. Respiratory problems can and will strike all ages and groups. Having a focused reference might prove invaluable.

Where Women Have No Doctor 2014 Update by Burns, Lovich, et al. Softbound. Publisher: Hesperian Foundation ISBN-10: 0942364252 List price: $26.95
Helps individuals understand, treat, and prevent most health problems affecting women. Considered an essential resource for women wanting to improve their health, as well as for health workers seeking information about the problems that affect only women, or affect women differently from men. Very third world poverty oriented yet useful where there is no regular health care access.

Where There Is No Psychiatrist: A Mental Health Care Manual by Vikram Patel. Publisher: Royal College of Psychiatrists (2003) ISBN 1-901242-75-7 Softcover, 266 pages. List price: approx. $12.00
A practical manual for mental health care for the community health worker regardless of level of training. Mental health care will be at a premium during times of significant stress. Though the book often suggests getting the person to an actual doctor for prescription medication it is the only book available than can guide the austere care worker through the process of Cognitive Therapy, which is a widely-used form of counseling, used either alongside medication or as a stand-alone therapy.
Also recommended in the *I Am Just Getting Started* section.

Clinical Assessment and Diagnostic Skills for Nurses, Paramedics and ECPs 2nd Edition By Chris Breen and Dr. Craig Ellis. Published by CreateSpace Independent Publishing Platform ASIN: B01K1603XQ
Softcover, 335 pages. Black and white illustrations.
A basic assessment guide that covers a lot of ground, updated to include blast injuries, gunshot wounds, and nuclear, biological and chemical incidents. A good reference for intermediate and advanced care providers.
Published in both the UK and the US.
List price $22.21 in the US from Lulu.com

http://www.lulu.com/shop/chris-breen-dr-craig-ellis/clinical-assessment-and-diagnostic-skills-for-nurses-paramedics-and-ecps/paperback/product-20043405.html
24.99 Pounds Sterling in the UK from SP Services
https://www.spservices.co.uk/item/Brand_ClinicalAssessmentandDiagnosticSkillsforNursesParamedicsandECPs_124_0_3964_1.html
Used copies can be found through Amazon.com though they often command prices over the published list.

The Survival Guide: What To Do in a Biological, Chemical or Nuclear Emergency by Angelo Acquista, M.D. 284 pages. Random House Trade Paperbacks. (2003) ISBN 0-8129-6954-5 Large paperback format. $12.95 USD.
The quick, to-the-point book for the layperson seeking fast, authoritative information on dealing with nuclear, biological, or chemical attack without getting bogged down in detail. Highly recommended.

Improvised Medicine: Providing Care In Extreme Environments 2nd Edition by Kenneth V. Iserson, MD. Published by McGraw-Hill Education / Medical January 2016. ISBN-10: 0071847626 Softcover, 688 pages. List price $99.00 Also available in a Kindle edition ($55.20)
More than just a what-to-do book this is a how-to: how to fashion surgical equipment from common items, improvise endotracheal tubes and esophageal stethoscopes, make plaster cast bandages and much more. Wide use of black and white illustrations instruments to show a procedure or the end result of an improvisation. This book should be on the shelf of every doctor and advanced care practitioner concerned about improvising care under disaster conditions.
The definitive book for practitioners who are called to work in a resource-poor setting. Dr. Iserson has practiced in environments as extreme as Antarctica, taught emergency medicine and works with a desert search and rescue team.

Nursing 2017 Drug Handbook (Nursing Drug Handbook) Thirty-Seventh Edition, Lippincott and Williams Publishers (new 38th edition due out May 2017). 1,736 pages, softcover. ISBN-10: 149632255X $44.99 list on Amazon ($25.95 for Prime customers)
A thorough, easy-to-read drug reference intended for nurses but very useful for non-medical types also. Much easier to navigate and understand than the PDR, and it offers more info of use to bedside caregivers as well. Little difference between current and past years editions so if cost is an issue opt for a slightly older edition. Most updates of this and other nursing drug references are only for new medications that are not likely to be encountered in the austere medicine setting.

Saunders Nursing Drug Handbook 2017, 2017 ed. by Robert J. Kizior BS RPh (Author), Barbara B. Hodgson. W.B. Saunders, Publisher. Softcover, 1,552 pages. ISBN-10: 0323442919 $34.08 on Amazon.com
Another excellent choice for a bedside drug handbook, offering interactions, common side effects and adverse reactions and black box alerts. Unique to this book are frequently used herb monographs and interactions. If herbal remedies are to be employed alongside modern pharmaceuticals, this may be a better choice for your library.

Save Lives Save Limbs by Hans Husum et al. Published by the Third World Network. Copyright 2000. Softbound, 530 pages. ISBN 983-9747-42-8 List: $20.00 to developed nations.
Developed for village medics in contested areas. Covers topics ranging from land mine identification to an illustrated guide of performing an emergency laparotomy without the benefit of a hospital. The techniques may also apply to some non-combat injuries. Very seldom seen in the US but very much

worth pursuing. Written from a very humanitarian aspect it nevertheless brings life-saving trauma surgery to its most basic level. Very well illustrated with color photos.
This book is now available as a free download in pdf format.
http://traumatologi.no/save-lives-save-limbs-life-support-to-victims-of-mines-wars-and-accident/#1489658873117-42af2de5-f23d

War Surgery, Field Manual 2nd Edition by Hans Husum et al. Third World Network, 2011. Softbound, 880 pages. IS ISBN: 978-983-2729-21-1 List price $140.00 to developed nations. https://twnshop.com/
The definitive war and field surgery manual that exceeds all others when looked at from the aspect of a non-trauma surgeon. Lists many needed considerations ranging from materials for a rough field hospital to tools and medications for advanced field surgical techniques. Extremely readable and well-illustrated with clear line drawings.

What a Pharmacist Knows That You Should Too: A Guide to Over-the-Counter Medications by Michael Lawler. Self-published in 2015. Paperback, 251 pages. ASIN: B0118UVW84 List price $25.00 through third party seller on Amazon.com
What a Pharmacist Knows … contains the most common questions asked at the pharmacy and takes an evidence-based approach to answering them to determine what works, why it works, and how it works. This book is intended for young adults, parents with children, healthcare professionals, students of these disciplines, and anyone who is concerned about their health.

Mosby's Medical Dictionary 10th Edition (Trade Version) Published May 2016 Hardcover: 2,000 pages. List price $43.95 (Amazon) ISBN-10: 0323414257
Not to be confused with the more expensive (and unnecessary) Nursing and Allied Health version. Easy to read and makes liberal use of color plates to illustrate everything from anatomical references to a standard instrument array for basic patient assessment. A better choice for Paramedic-level and below providers.

Stedman's Medical Dictionary for the Health Professions and Nursing Published by Stedman's April 2011. Hardcover, 2,439 pages. List price $47.99 (Amazon) ISBN-10: 1608316920
Another very worthwhile medical dictionary, more advanced than the Mosby's offering. Numerous tables present complicated information in schematic format to facilitate learning. 1,000 color images and photgraphs, glossy anatomical inserts and 65 appendixes. A better choice for nurses and higher level providers.

3. Valuable Additions

Not primary recommendations but instead, additional references that may be considered when the basics are covered. Concentrate on the previous section first, and then refer to this for additional considerations that will help you round out your primary library.

The Merck Manual Home Health Handbook 3rd Edition. Published by Wiley, copyright October 2011. Softcover, 2,352 pages. ISBN-10: 1118115422 List price $24.95.

Written for the non-medical person, yet it mimics the information in the manual intended for doctors but using non-technical language. An excellent choice for non-clinical users.

The Merck Manual of Patient Symptoms: A Concise, Practical Guide to Etiology, Evaluation, and Treatment by Robert S. Porter. Published by Merck and Co., copyright September 2008. Softcover, 670 pages. ISBN-10: 0911910115 List price $24.95.
A more clinically oriented version of the Home Health Handbook though organized in much the same manner.

Basic Counseling Techniques: A Beginning Therapist's Tool Kit by C. Wayne Perry. Published by AuthorHouse January 2008. Softcover, 362 pages. ISBN-10: 1434355241 List price $18.99
The author is a Doctor of Ministry and has 20 years of counseling and teaching at the university level. This book is intended for beginning therapists who have questions about patients who don't seem to fit the normal profile seen by marriage and family therapists. Rather than a true mental health manual it offers valuable tools for providing counseling to persons who may be overwhelmed by drastic changes in their lives and the affects these have on their families. Recommended as an adjunct for Where There Is No Psychiatrist rather than as a primary mental healthcare manual.

Surgical Care at the District Hospital by the World Health Organization. Published by New Age International Pvt Ltd Publishers December 2005. Softcover, 444 pages. ISBN-10: 8122415962 List price $80.00 (commercial reprint)
Also available as a free pdf direct from WHO. Original 2003 release.
http://www.who.int/surgery/publications/en/SCDH.pdf?ua=1
Hard copies may be ordered from WHO for $60, or CHF 25 (Swiss Franc) for developing countries
http://apps.who.int/bookorders/anglais/detart1.jsp?sesslan=1&codlan=1&codcol=15&codcch=522
The manual is a successor of three earlier publications that are widely used throughout the world and that remain important reference texts: General Surgery at the District Hospital (WHO, 1988), Surgery at the District Hospital: Obstetrics Gynaecology,Orthopaedics and Traumatology (WHO, 1991), Anaesthesia at the District Hospital (WHO, 1988; second edition 2000).
This new manual draws together material from these three publications into a single volume which includes new and updated material, as well as material from Managing Complications in Pregnancy and Childbirth: A Guide for Midwives and Doctors (WHO, 2000).
It is intended to increase the standards of care at outlying developing-world hospitals where regular surgical staff is not available. Worthy of strong consideration for any low resource setting in a post-disaster world.

Orthopaedic Care at the District Hospital by A Doorgakant, Prof N Mkandawire. Published by A Doorgakant. Copyright 2013. Softcover, 432 pages. Illustrated with black and white photos and clear line drawings. ISBN: 9780992701802
List price 5 Pounds Sterling from TALC http://www.talcuk.org/books/orthopaedic-care-at-the-district-hospital.htm
Also available on-line (viewable but not able to be downloaded): http://www.orthopaedic-care.co.uk/?cat=6
Basic techniques intended for low resource settings, and as an educational tool for future orthopedic surgeons. The author practices in the country of Malawi.

Mosby's Handbook of Herbs & Natural Supplements 4th Edition by Linda Skidmore Roth, RN, MSN. Published by Mosby May 2009. Softcover, 768 pages. List price $52.95 ISBN-10: 0323057411

Mimics Mosby's regular drug guides with its new format, making it much easier to find information more easily. Now includes references to pregnancy and lactation considerations as well. Extensively reviewed by nurses and herbalists alike.

Ditch Medicine: Advanced Field Procedures For Emergencies by Hugh Coffee Paladin Press; (May 1993) Hardcover, 224 pages, B/W photos and drawings. ISBN 1-58160-390-8 $25.00
http://www.paladin-press.com/default.aspx
Quick and dirty advanced medical care, whether the scene is a war zone or in a ditch. Advanced field procedures for small wound repair, infected wound care, IV therapy, pain control, amputations, burns, airway procedures and more. The skills illustrated in the book work the same today as they did when the book was published. The author presumes you know what to do, and concentrates on teaching you how.

4. Medical Professionals

It is not inconceivable to expect that during times of crisis or prolonged disaster many doctors and other healthcare professionals may be asked, or even expected to offer services outside of their normal practice. This section is intended to recommend suitable references for them in order to enhance and expand upon their existing skills. References for clinical assessment, wound care and closure, anesthesia, dermatology and much more are included. These should be considered to be additions to previously recommended references. Needless to say, tailor your library to meet your needs and expectations.

Fast Facts for the Wound Care Nurse: Practical Wound Management In A Nutshell by Zelia Kifer RN BSN CWS. Softcover, 304 pages, color photos and other illustrations and graphs. Springer Publishing Company, Copyright October 2011. ISBN-10: 0826107753 List price $35.00.
This not a basic nuts-and-bolts wound care manual. It is intended for trained medical practitioners (nurses and above). Some of the recommendations will carry over into the austere environment, and others will not because on their reliance in high-tech chemistry and/or equipment. Some will of course fall in between, so if the power is on and the local water supply is clean you are halfway to offering currently-recommended wound care therapy if you have access to the more common products recommended in this manual.

Clinical Examination: A Systematic Guide to Clinical Diagnosis by Nicholas J. Talley and Simon O'Conner. Blackwell Science Inc; 7th edition (October 2013) Softcover 624 pages. ISBN-10: 0729541479 List price $123.00. Occasionally steeply discounted on Amazon.com
A staple for medical school and highly recommended, though not for laypersons. Advanced practitioners will, however, appreciate it vs. Jarvis

Bates' Guide to Physical Examination and History Taking 12th Edition (September 2016) by Lynn S. Bickley, MD, FACP. Lippincott, Williams, and Wilkins, publisher. Hardcover, 1,072 pages. ISBN-10: 146989341X $129.99
For serious physical exams, supercedes the Jarvis book recommended in the Primary References section. Extremely well illustrated with updated dermatology photos and an updated chapter on evaluating clinical evidence. Differential diagnoses of abnormalities are also offered as a useful tool.

Bates' Pocket Guide to Physical Examination and History Taking 8th Edition (October 2016) by Lynn S. Bickley, MD, FACP. Lippincott, Williams, and Wilkins, publisher. ISBN-10: 1496338480 Softcover, 432 pages.
The smaller pocket guide to the previous reference it is offered as a less expensive alternative in a more concise format. Photographs and illustrations remain though fewer in number.

Minor Emergencies: Expert Consult – 3rd Edition (July 2012) by Stephen M. Leffler MD FACEP and Philip Buttaravoli MD FACEP. Published by Saunders. ISBN-10: 0323079091 Softcover, 848 pages. List price $89.99 USD, 56.99 Pounds Sterling in the UK.
Highly recommended for the ER (Casualty), doctor's office or Urgent Care clinic. Details nearly 200 common minor emergencies, how to diagnose and treat them. Includes active links to 2-3 minute on-line videos that show, for instance, how to remove an impaled fishhook or perform a joint reduction. This book covers the basic emergencies that the surgery-oriented books overlook.

Remote and Austere Medicine: A Field Guide for Practitioners 1st Edition May 2017 by O'Kelly et al. Published by the College of Remote and Offshore Medicine. Pocket guide size, 198 pages, very well illustrated and colorized for rapid reference. Price not available at the time of this publication though it is scheduled for release on Amazon.
Intended for Paramedic-level and above practitioners serving in tropical climates it is also in the opinion of this author the most useful field guide to quick how-tos, useful mnemonics for assessment, quick protocol access, drug formulary and prolonged field care available. The tropical-oriented section comprises only a modest part of the book, and any ER, in-field or even Intensive Care practitioner will find the majority of this work regularly useful.

Atlas of Clinical Dermatology, 4th Edition by Anthony du Vivier MD FRCP Published by Saunders December 2012. ISBN-10: 0702034215 Hardcover, 742 pages. British English. Extensively illustrated with color photos. List price $194.48 via Amazon.
One of the more highly recommended dermatology references, this book contains over 2,300 color images, offering different presentations of the same disease, including across various skin types and coloration. Assessment, diagnosis and treatment are included. An incalculable resource.

Anaesthesia at the District Hospital, 2nd Edition by Dr. M.B. Dobson. Publisher: World Health Organization (2001). Paperback, 153 pages. ISBN: 9241545275 List price: not applicable. Can be found used through Amazon. Also available through TALC http://www.talcuk.org/a-z_booklist.htm
Also available for free download as a pdf document (link active as of May 2017):
https://www.k4health.org/sites/default/files/WHO%20Anesthesia%20at%20the%20district%20hosp%202ed.pdf
Written for physicians at remote hospitals in overseas locations. The intended audience is doctors with at least one year of post-graduate experience. Various types of anesthesia including general, regional, and local. A definite must-have for physicians and others contemplating the need for any manner of surgery. Well-illustrated with clear black and white drawings.

Safe Anaesthesia, 3rd Edition: A Training Manual - Where Facilities Are Limited by Lucille Bartholomeusz (1986), revised by Jean Lees (2006) ISBN 1862528764 Softcover, 469 pages, illustrated. List price 12 Pounds Sterling Available through TALC http://www.talcuk.org/books/safe-anaesthesia-3rd-edition.htm
Completely revised in line with current anesthetic teaching and with new chapters on hypothermia and acute pain relief, this book aims to cover most aspects of anesthesia, including basic anesthesia as well

as more unusual surgical procedures, medical problems and complications. The techniques described have been successfully used in developing countries and embody safe, modern principles using the drugs, equipment and facilities available.

Primary Anaesthesia Edited by Maurice King. Published by Oxford University Press 1986. ISBN 9780192615923 Softcover. 288 pages. List price 40.05 Pounds Sterling through TALC. http://www.talcuk.org/books/primary-anaesthesia.htm
Used copies available through Amazon though much higher priced.
This is the original work intended for third world hospitals. It is superseded by the revised work listed above (Anesthesia at the District Hospital) but is offered as an alternative. Written for nonspecialists, this useful manual provides sufficient detail to allow inexperienced clinicians and medical students to give an anesthetic in an unexpected or emergency situation. The author covers the use of ether with air as a carrier gas; ketamine, epidural, and subarachnoid anesthesia; various methods of local and regional anesthesia; intubation; and the use of relaxants. There is also a chapter on primary intensive care, and an appendix featuring a detailed list of equipment.
From an on-line review: "Many interesting drawings and tables are included. An ingenious table with a logarithmic scale shows doses of many anaesthetic drugs for all sizes of patient. If you have a non-anaesthetist friend going to practise medicine in the jungle, give him or her a copy of this book. It is sure to save lives."

Anesthesia Care of Pediatric Patients In Developing Countries by George A. Gregory, M.D. and Dean B. Andropoulos, M.D. Published by Global Health. Copyright September 2014. 707 pages. Available only as a free download in pdf format. Illustrations and photos (color)
Statement by the authors regarding distribution: "In many instances it may be appropriate for one person or a group of people to download the book and to reproduce it for distribution to other anesthetists."
http://global-help.org/publications/books/help_anesthesiapediatrics.pdf
Authors' purpose: For anesthesia to be safe, the anesthetist must understand the many physiologic and pharmacologic differences between children and adults. Providing anesthesia by a formula (giving a specific amount of a drug by some formula, e.g., mg/kg), as is often done, is dangerous and can be disastrous for some patients.
Intended for medical professionals who may be called upon to provide anesthesia services under austere circumstances without proper references to guide them.

Essential Drugs Practical Guidelines (2013 edition) by J Pinel, F Weiss, M Henkens, V Grouzard (eds.) Published by Médecins sans frontiers (Doctors Without Borders) Softcover. 360 pages. List price 11.40 Pounds Sterling Available through TALC http://www.talcuk.org/books/essential-drugs-practical-guidelines-2013-edition.htm
Also available as an on-line pdf document (2016 edition):
http://refbooks.msf.org/msf_docs/en/essential_drugs/ed_en.pdf
Essential drugs are those that satisfy the health care needs of the majority of the population, and are the drugs necessary to treat most of the more serious and frequent diseases, with the best benefits/risk ratio in their therapeutic classification. This book is a practical guide intended for physicians, pharmacists, nurses and medical auxiliaries and provides information necessary for the correct use of essential drugs, with drug sheets intended for medical practice, and with particular attention paid to the exact dosages for children.

Practical Plastic Surgery for Nonsurgeons by Nadine Semer MD. Published by Authors Choice Press July 2007 Softcover, 404 pages. Illustrated. ISBN: 9780595461899 List price $26.95 through Amazon.
Also available as a free pdf file with more clear images than found in the print edition. 385 pages.
http://global-help.org/publications/books/help_practicalplasticsurgery.pdf
From the Preface: "The intent of this book is to bring relief to people who sustain commonly encountered injuries and wounds. Without corrective treatment, these problems can destroy livelihoods and families. Immediate, acute care often stabilizes the patient, but may leave the patient with a minor or major disability. Lacking the resources typical of wealthier populations, even minor disabilities can have a devastating economic and social impact.
Plastic surgeons have developed reconstructive surgical techniques that can restore the injured person to a productive and fulfilling life. Unfortunately, this type of surgery has frequently been obscured by a cloud of unawareness or perceived difficulty.
"Practical Plastic Surgery For Nonsurgeons" describes straightforward plastic surgical information and techniques. This book will be useful to health- care providers with limited access to specialists, especially providers who serve in rural and non-industrial settings. Medical students, nurse practitioner students, and residents in a wide variety of specialties will also benefit from this knowledge."

Emergency War Surgery 4th Revision by Borden Institute, US Army Medical Department Center and School. Revised 2013. Published by Dept. of the Army ISBN-10: 016086402X List price: $48.95 Harcover, 589 pages.
Available through 3rd party sellers only, new and used. Earlier editions contain information no longer considered to be appropriate. Primarily intended for military surgeons.

Primary Surgery Volume One: Non-Trauma by Maurice H. King (Editor), Lowell King. Paperback: 600 pages, line drawings. Oxford University Press; (April 1994). ASIN: 0192615998 List price: Approx. $22.00 US, available from http://www.talcuk.org/a-z_booklist.htm#S_
Trauma methods which the non-specialist doctor can use. Designed mainly for medical schools and hospitals in the third world. A valuable feature is a system of closed fracture management and an extensive chapter on the treatment of burns. Available without the illustrations as a free download. Get a bound paper edition if you can.
http://www.meb.uni-bonn.de/dtc/primsurg/index.html (link valid as of May 2017)

Primary Surgery Volume One, **2nd Edition** Edited by Michael Cotton Published by Global Health Education Low-cost Publications, 2016 881 pages, Black and white, illustrated. ISBN-13 #978-1-60189-162-4
This revised and updated edition is based on the original book by Maurice King. It is available exclusively as a free download in pdf format and does not seem to be available in hard copy.
http://global-help.org/products/primary-surgery/
http://global-help.org/publications/books/help_primarysurgery.pdf

Primary Surgery Volume Two: Trauma by Maurice H. King (Editor). Paperback, Oxford University Press; (August 1993). ASIN: 0192616935 List price: Approx. $22.00 US, available from
http://www.talcuk.org/books/primary-surgery-vol-2---trauma.htm
This is the second of a four volume system of surgery, anaesthetics and obstetrics for doctors in the district hospitals of the developing world. They are for non-specialist doctors and for medical students and describe what a doctor can do if he cannot refer a patient. Though superseded by the latest revision that combines aspects of all 4 volumes some may prefer the more singular aspect.

Professionals' Handbook of Complementary & Alternative Medicines, 3rd Ed. by C.W. Fetrow, PharmD, et al. Lippinincott, Williams and Wilkins, Published June 2003. Paperback: 956 pages. ISBN-10: 1582552436 List price: $31.55 Commonly available used for much less.
Detailed information on nearly 300 of the most commonly used herbal agents, including generic names, synonyms, common trade names, common forms, source, chemical components, actions, reported uses, dosage, adverse reactions, interactions, contraindications and precautions, special considerations, analysis, and references. Written in monograph form based on the results of clinical studies that compare existing evidence with manufacturers' claims.
Specialized info aimed at licensed practitioners rather than home users.

PDR for Nonprescription Drugs 2014, 35th edition. Published by PDR Network January 2014. Hardcover, 464 pages. ISBN-10: 1563638274 $59.95 on Amazon.com
Touted as the most comprehensive edition to date it offers information on commonly used over-the-counter medications such as analgesics, cough and cold remedies, fever reducing agents, allergy medications and more. Not a replacement for the regular drug handbook but perhaps more suited if access to prescription drugs isn't in the picture.
The following books have been recommended elsewhere in this chapter, and are included here in order to emphasize their importance for advanced care providers who are called to work outside of their normal practice area.

Where There Is No Psychiatrist: A Mental Health Care Manual by Vikram Patel. Publisher: Royal College of Psychiatrists (2003) ISBN 1-901242-75-7 Softcover, 266 pages. List price: approx. $12.00
A practical manual for mental health care for the community health worker regardless of level of training. Mental health care will be at a premium during times of significant stress. Though the book often suggests getting the person to an actual doctor for prescription medication it is the only book available than can guide the austere care worker through the process of Cognitive Therapy, which is a widely used form of counseling, used either alongside medication or as a stand-alone therapy.
Though also recommended in the I'm Just Getting Started category physicians and other trained medical care providers will benefit from the medication graphs, as well as the more general advice.

Improvised Medicine: Providing Care In Extreme Environments 2nd Edition by Kenneth V. Iserson, MD. Published by McGraw-Hill Education/Medical January 2016. ISBN-10: 0071847626 Softcover, 688 pages. List price $99.00 Also available in a Kindle edition ($55.20)
More than just a what-to-do book this is a how-to: how to fashion surgical equipment from common items, improvise endotracheal tubes and esophageal stethoscopes, make plaster cast bandages and much more. Wide use of black and white illustrations instruments to show a procedure or the end result of an improvisation. This book should be on the shelf of every doctor and advanced care practitioner concerned about improvising care under disaster conditions.
An outstanding reference for practitioners who are called to work in a resource-poor setting. Dr. Iserson has practiced in environments as extreme as Antarctica, taught emergency medicine and works with a desert search and rescue team.

Wounds and Lacerations: Emergency Care and Closure, 4th Edition by Alexander T. Trott, M.D. Published by Mosby-Yearbook, hardcover, 336 pages, 300+ illustrations. ISBN 0323074189 List price $65.73.

The definitive wound closure manual for non-surgeons. Easy to understand language and format that will not leave a layperson reeling but which a trained physician can easily relate to. More than 300 line drawings and photographs. Assessment, irrigation, administration of local anesthesia, foreign body removal, and just as importantly when NOT to close. MRSA wound guidelines also provided in this edition. Invaluable for advanced practitioners who do not routinely have to care for and close wounds.

Merck Manual of Diagnosis and Therapy, 19th Edition by Robert S. Porter (Editor). Published by Merck, copyright July 2011 Leather Bound Hardcover, 3,754 pages ISBN-10: 0911910190 List price $62.49
Dubbed the Bible of Medicine, the Merck Manual is a book condensed enough to cover all the major aspects of medicine in a text written such that, even though is targeted towards health care practitioners, can also be used by the educated layman. No matter what your primary specialty is you will find this a useful reference. If you already possess an earlier edition you may consider upgrading.

5. Uncategorized

This section is for references that do not easily fall into a previous category. They are intended to expand certain skills and increase overall knowledge. Some are highly specialized and may not be of interest to the average reader. Many are suited for long-term care considerations, however, and may be worth adding to your library if you anticipate an emergency period of long duration.

Wound Care (Quickstudy: Health) Pamphlet, laminated, 4 pages – June 20, 2002. List price $4.95
A simple, quick reference black and white pamphlet with color photos. Easy-to-understand wound care for commonly encountered problems such as diabetic foot ulcers, chronic wounds, pressure ulcers and more. If money is an issue and you need a basic wound care guide this may be the way to go. Commonly available in better bookstores with medical sections such as Barnes and Noble, and of course on-line through Amazon.com.

Incredibly Easy Series
The value of the Incredibly Easy series of medical books cannot be overstated. They are informative while also being fun to read with their use of color cartoons and speech balloons to make important points. They can be a good starting pointing for a medical novice, and a valuable resource for a medical professional seeking to learn more about topics outside their normal scope of practice through a non-intimidating avenue. They are not definitive sources of information but they are very useful for teaching and reinforcing basic fundamentals.

Wound Care Made Incredibly Easy 3rd Edition, published August 2013 by Lippincott Williams and Wilkins. Softcover, 288 pages. ISBN-10: 1496306317 List price $50.99 but available through Barnes and Noble on-line at $31.79. Lower pricing can occasionally be had from other sources. An excellent resource for those unskilled in dealing with problem wounds.
Chapters include: wound care fundamentals, assessment and monitoring, basic procedures and more.

Fluids & Electrolytes Made Incredibly Easy!/Edition 6, published February 2015 by Lippincott, Williams and Wilkins. Softcover, 392 pages. ISBN-10: 1451193963 List price $31.79 through Barnes and Noble.
Chapters include balancing fluids, balancing electrolytes, disorders that cause imbalances including respiratory failure, renal failure, burns, and excessive GI fluid loss and more.

Nursing Pharmacology Made Incredibly Easy/Edition 3 Published May 2012 by Lippincott Williams and Wilkins. Softcover, 736 pages. ISBN-10: 1451146248 List price $39.99 through Barnes and Noble. Easy-to-understand information on how drugs work and interact with each other. Cautions to be observed before administering a drug, and even patient teaching information. Written in the fun style of the other titles in the Incredibly Easy series.

Respiratory Care Made Incredibly Easy!/Edition 1, Published April 2004 by Lippincott, Williams and Wilkins. Softcover, 352 pages. ISBN-10: 1582553351 List price $37.17 from Barnes and Noble. Covers assessment, treatments, infection and inflammation, traumatic injuries, respiratory emergencies and more. Geared more towards in-hospital healthcare workers yet offers some invaluable insights and tools for basic respiratory care as well.

The Ship's Medicine Chest and Medical Aid At Sea, 2003 revision US Public Health Service. DHHS Publication No. (PHS) 03-2024 410 pages.
Available on-line as a free download. https://fas.org/irp/doddir/milmed/ships.pdf
Poorly illustrated, perhaps one picture every 50 pages. It is more valuable as a study guide than as an actual medical guide. Significantly inferior to the UK version.

The Ship's Captains Medical Guide – UK version of the above, 2014 printing, published by Her Majesty's Stationary Office.
https://www.gov.uk/government/publications/the-ship-captains-medical-guide
Current URL as of May 2017. 13 chapters and 1 annex, separately downloadable in .pdf format
Both books are written for people with next to no medical training. Good basic coverage of hygiene, nursing and medical care with limited on-hand resources. The most recent edition is of the UK version – it is available on the above site and is in our opinion is the better of the two.

The Student's Anatomy of Exercise Manual Chief Consultant – Professor Ken Ashwell, B. Med. Sc., Ph. D. Published 2012 by Global Book Publishing Pty Ltd, NSW, Australia. Softcover, 192 pages. List price $24.99 USD, $28.50 CA
A nice-to-have reference for physical therapy or strengthening regimens. Not a substitute for an actual physical therapy manual. Multi-color illustrations that clearly show the combination of exercises and the affected muscles. Available through Barnes and Noble and Amazon.

Making Health-Care Equipment - Ideas for Local Design and Production by Adam Platt and Nicola Carter. Published by Intermediate Technology Publications 1990. ISBN 1853390674 Available through TALC List price 10.90 Pounds Sterling
http://www.talcuk.org/books/making-health-care-equipment---ideas-for-local-design-and-production.htm
This manual contains illustrated step-by-step instructions for making locally produced health care equipment such as folding beds, ward screens, wheelchairs and mobility aides, designed to suit the community's needs and resources, equipment which is both cheaper and more easily maintained than imported items. Ideas and designs are included for hospital furniture, tricycles, carts, physiotherapy and orthopaedics, laboratories, and maternity and child care. There is also information about basic construction and marketing methods and a list of resources from which further information may be obtained. Best suited to community-level interests.

Gray's Anatomy: The Anatomical Basis of Medicine & Surgery by Henry Clay, Lawrence H. Bannister (Editor), Martin M. Berry (Editor), Peter L. Williams (Editor). Publisher: Barnes and Noble, October 2013 Hardcover: 1,280 pages. ISBN-10: 1435145461 List price is $205.00
Various editions and printings are available. The book is easily found in used condition for very little money, and even new copies can be found for under $20 through on-line booksellers. Recommended for reference purposes and study only. Not a priority item unless you plan on attending medical school.

SOF Combat Casualty Care Handbook – Tactics, Techniques, and Procedures by the Combined Arms Center. Published by CreateSpace Independent Publishing Platform, November 2013. Paperback, 60 pages. ISBN-10: 1493685333 List price $5.25 from Amazon.com
Intended as a hip pocket field reference of the tactics and procedures relevant to Special Operations Forces combat casualty care. Originally distributed as a supplement to the Journal of Special Operations Medicine.

Wilderness Medicine: Beyond First Aid, 6th Edition by William Forgey, M.D., Falcon Guides Printing November 2012. Paperback 288 pages ISBN-10: 0762780703 List price $16.95
Tells how to recognize, assess, and treat the most commonly encountered medical emergencies in the wilderness. It has been described by one well-qualified reviewer as "selectively thorough." Fully revised, updated and illustrated.

Wilderness Medicine, 7th Edition, 2-Volume Set by Paul S. Auerbach et al. Published by Elsevier November 2016. ISBN-10: 0323359426 Hardcover, 2,840 pages. List price $209.99
Reference includes diagnostic and treatment protocols, definitions, clinical presentations, and more. How-to explanations and practical approaches to emergencies, and information on children and women in the wilderness. Extremely comprehensive but best consulted before an emergency occurs due to its cumbersome size.

Special Operations Forces Medical Handbook, 2nd Edition Edited by Farr, Fenton, Clayton, Thompson and Pavliscsak. Published by the US Government Printing Office, November 2008. Ring-bound, 750 pages. ISBN-10: 0160808960 New copies start at $88.50 from third party sellers. Used copies often available for less.
The updated version of the previous Special Forces Medical Handbook and others. Assumes the reader has at least paramedic-level training and is familiar with the procedures. An excellent if heavy field guide. Other books offer the same info in more detailed form, making them more useful for semi-skilled personnel. However for those with a paramedic or higher background this book bridges the gap from pre-hospital care to the full spectrum of medicine. It is intended primarily for combat-zone medicine and is a poor choice for civilian-only environments.

Tools of the Trade and Rules of the Road: A Surgical Guide, by Edwin A. Deitch, MD. Publisher: Lippincott & Williams, (June 1997). Softbound, 368 pages. 340 line drawings. ISBN: 0-397-51393-3 Out of print.
Fundamental surgical guidelines and techniques in a forthright, easy-to-read style. Covers such topics as knot-tying, retractor selection, and techniques for stopping bleeding. Detailed line drawings illustrate surgical principles and techniques. Covers basic principles the other books leave out but cannot be considered to be a primary reference. Used copies widely available through third party sellers but prices are high, starting at double the original list price. Prices begin at $91.00 and increasing rapidly from there. If an inexpensive used copy happens to be found grab it, but don't make it the first surgical reference you look for.

Communicable and Non-Communicable Disease Basics: A Primer by Madeline M. Hurster. Published by Praeger, November 1997. ISBN-10: 0897895088 Softcover. List price $27.95 Hardcover also available.
A basic primer in what disease is and how it affects humans. This is not a how-to manual but rather provides information needed to understand how diseases can be spread. The language is basic medical rather than scientific, making it easy for non-medical people to understand.

Essentials of Paramedic Care Update 2nd Edition by Bryan E. Bledsoe, Robert S. Porter, and Richard A. Cherry. Published by Prentice-Hall May 2010. Hardcover, 2,088 pages. ISBN-10: 013215689X
Does not currently seem to be a stock item for on-line sellers. List price was over $200 when last offered.

Nancy Caroline's Emergency Care In The Streets 7th Edition (2 Volume set) (Orange Book) by American Academy of Orthopaedic Surgeons (AAOS) (Author), Nancy L. Caroline (Author), Bob Elling (Author), Mike Smith (Author). Published by Jones & Bartlett Learning. Released August 2012. Hardcover, 2,200 pages. List price $318.95, available through Amazon.com for $149.35 as of May 2017. ISBN-10: 1449645860
Significantly updated to reflect 2010 DOT standards. Does not replace a Basic EMT text but is rather the next step.

Merck Veterinary Manual 11th Edition by Susan E. Aiello a Michael A. Moses. Publisher: Merck, July 2011. Hardcover: 3,325 pages. ISBN-10: 0911910611 List price $65.00
Covers all domesticated species worldwide. Hundreds of color images and a two-column, color format for easier reading.

Where There Is No Vet by Bill Forse. Softbound. ISBN: 0-333-58899-1 List price: $24.95
http://www.lehmans.com/jump.jsp?ite...iProductID=3378
A detailed and fascinating book covering all aspects of animal illness, disease, trauma and medication. Sections on prevention and treatment of disease, pregnancy and birthing, and emergencies, and simple operations. A valuable handbook for all who raise animals and are responsible for their care. Primarily tropical environment oriented.

USAMRIID Medical Management of Biological Casualties Handbook 7th Edition
Though not an austere care reference per se, it offers significant food for thought as well as authorative information regarding the possible employment of biological agents and how to differentiate that from a casual encounter with something naturally occurring. This is the latest edition, released in September of 2011.
The book is available as a free pdf document.
http://www.usamriid.army.mil/education/bluebookpdf/USAMRIID%20BlueBook%207th%20Edition%20-%20Sep%202011.pdf
This book is also available in hard copy format through Amazon.com and Barnes and Noble.
CreateSpace Independent Publishing Platform; 7th edition January 6, 2013. Paperback, 280 pages. ISBN-10: 1481911538 List price: $14.95

The Medical Consequences of Nuclear War
Published by the Office of the Surgeon General Department of the Army, United States of America. Publication date was not found but seems to be circa 1989. It is a part of the Textbook of Military Medicine and is a publically available document.
Free pdf download.
http://documents.theblackvault.com/documents/nuclear/medconsq.pdf

Veterinary references

Animal Husbandry References

As a rule, well cared-for animals are healthy animals. The following books are excellent resources for the beginning farmer and have a lot to offer to seasoned homesteaders as well.

1. Publications by Christian Veterinary Mission (CVM) include the **Raising Healthy Animals** Series**.** Nine concise books cover individual aspects of raising healthy farm animals and include goats, cattle, sheep, pigs, poultry, rabbits, honey bees, horses and fish. Each book is a wealth of information, especially concerning the feeding, care and maintenance of the animal in less than optimal conditions (i.e. Third World country).

   Also of interest on the CVM bookstore website are the following books: *Slaughter and the Preservation of Meat* and *Zoonoses* (diseases that can be spread between animals and humans). CVM also publishes the book *Where There Is No Animal Doctor*. Their website links to how to purchase the books, but most can be found on Amazon.
   http://cvmusa.org/resources/store/book-store/

2. **Handbook of Livestock Management** by Richard A. Battaglia
   A more in-depth book on the care of beef cattle, dairy cattle, swine, horses, sheep, goats and poultry. With ample drawings, the book explains proper handling techniques and management practices such as vaccinations, shearing of sheep, trimming hooves, etc. It also includes clear descriptions of basic veterinary procedures not to be found elsewhere—pregnancy palpation of cattle, basics of assisted delivery of calves, dehorning, hoof trimming and castration, just to name a few. I am not familiar with newer versions of the book, but the 3rd edition contains adequate information for the lay person. You need this book if you are going to raise animals.

3. **Small-scale Pig Raising** by Dirk van Loon
   We have found this book to be helpful in our small hog-raising operation. It covers housing techniques, swine nutrition and reproduction among others. We have the 1978 version, found easily for a few bucks on eBay, and worth the money.

Veterinary Medicine References

These books are written to the veterinary professional and are not particularly layperson friendly. However, if one desires to focus solely on veterinary medicine after collapse these books will come in handy. A good veterinary medical dictionary can be used alongside them in many instances. I have listed the most useful books first.

1. **Where There Is No Animal Doctor** by Quesenberry & Birmingham
   This book is a must-have for any survival medicine library. It could very easily be a sister book to *Where There Is No Doctor* and is written to the layperson. The book begins with the basics of health & disease and how to perform a physical exam and addresses animal restraint and handling, nutrition, and covers most diseases that will be encountered on a regular basis, organized by body system. It gives detailed instructions on how to treat diseases mentioned and, importantly, includes a section on public health diseases. Castration of large animals is illustrated but no additional surgeries are discussed. A veterinary formulary is also included.

2. **The Merck Veterinary Manual**
   A reference book that covers almost any veterinary disease you can think of, in most domestic animals. It is somewhat difficult to navigate and even harder, at times, to understand. The manual includes pathophysiology, clinical signs and lesions, diagnosis and treatment for each disease. It uses veterinary terminology extensively and can be overwhelming. It does, however, include some valuable reference tables, particularly vital signs such as temperature, heart rate and respiratory rate in various domestic animals. If you can pick up an older edition for a small fee it is worth having around. 8th edition or newer is desired.

3. **Veterinary Medicine: A textbook of the diseases of cattle, horses, sheep, pigs and goats** by Radostits & Gay.
   A very large textbook covering in depth, the diseases of farm animals, along with treatment and control information. I list the book as "important" because it includes the major farm animals of interest in one text. It is an internal medicine textbook and does not cover common large animal maladies such as calving/birthing problems, nutrition or surgeries. The 10th edition is hard to find and 11th ed. is expensive.

   There is a link to download the entire 10th edition textbook (quite remarkable!):
   https://ia800202.us.archive.org/24/items/BLOODRADOSTITSVeterinaryMedicine10thEdition/BLOOD%20RADOSTITS%20Veterinary%20Medicine%2010th%20Edition.pdf

4. **Saunders Handbook of Veterinary Drugs** by Papich.
   A good, solid reference for using veterinary drugs. This book provides concise info about each drug—brief pharmacology and mechanism of action, indications and uses, precautionary info,

instructions for use, formulations, withdraw/regulatory information when using drugs in food animals, stability & storage, etc. in a readable format. Very good reference to have.

5. **Plumb's Veterinary Drug Handbook** by Plumb.
   This is the go-to drug reference book in the veterinary world. It has exhaustive information on all the topics listed above under previous drug handbook, and the details are often overwhelming. Older editions should be adequate for the drugs likely to be available post-collapse.

6. ***Sheep and Goat Medicine*** by Pugh & Baird
   Good reference book for the species it covers. Covers basic management & herd health information, which is especially important in small ruminants. Good explanation of diseases, treatment and control.

7. **Clinical Veterinary Advisor: The Horse** by D. Wilson
   The Clinical Vet Advisor books are helpful because they cover not only diseases but they also include sections on procedures and techniques, laboratory findings, differential diagnoses lists and a drug formulary. There is also a Dog and Cat book available.

8. **Farm Animal Medicine & Surgery for Small Animal Veterinarians** by Duncanson
   This book is written by our friends in the UK and there are some terminology differences. It appears to be a well-rounded little book, covering the most important details on diseases in cattle, sheep, goats, camelids (llama and alpaca), pigs and poultry. Surgical instructions are brief and leave to be desired with no illustrations included. It is, however, a cheaper alternative to the **Farm Animal Surgery** book, and can be used along with a decent anatomy book as a reference for surgeries.

9. **Farm Animal Surgery** by Fubini & Ducharme
   This very thorough text covers any surgery you can imagine on farm animals, from digit amputation to replacement of a left displaced abomasum. A detailed description of each surgery is given, with discussion on pre and post-operative considerations and different surgical techniques. This book will give you good direction on how to perform a caesarian section, replace a prolapsed uterus or rectum, and provide surgical considerations on wound repair of food animals but is otherwise more in-depth than desired unless you are a veterinary surgeon.

10. **Anatomy of Domestic Animals** by Pasquini, Spurgeon & Pasquini
    Hand-drawn illustrations accompany a brief description of the anatomy of domestic animals in this book. It has your classic layer-by-layer approach to anatomy, organized by system and species. A good anatomy reference book for the dog, horse and cow with the occasional reference to pigs & sheep. It contains a good amount of discussion about anatomical parts, their function and clinical relevance, as well as species differences. Pasquini is a veterinary professor who has written multiple books and the ones I have encountered are very useful.

11. **Textbook of Veterinary Anatomy** by Dyce, Sack & Wensing
    Textbook that is rich in description of veterinary anatomy and how it applies clinically (what you can expect to see in the animal). There are many illustrations and a few color plates. A good book to have to deepen your understanding of veterinary anatomy. My experience is only with the 3rd edition, but have heard the 4th edition includes color illustrations which is an improvement.

    Note on Anatomy books: There are many other texts available out there. These are the ones I am familiar with, so they are listed here. I'm sure one could find a decent text for cheaper than the ones listed above.

Appendices:

Appendix 1: Water Purification & Treatment

Preparation of Water for Drinking and Medical Use

Water purification and disinfection

Water found in nature should be processed to eliminate two basic kinds of contaminants: gross debris and microscopic contaminants. Gross debris can be easily seen—dirt, leaves, sand, etc. Microscopic contaminants cannot be seen and may include organic material, pathogens, chemicals and other pollutants. Organic compounds come from the break-down of living things such as plants, animals and animal waste. It is the organic material that bacteria use as a food source to replicate, and the amount of organic material that determines what level of treatment is needed to purify the water.

In general, purification of water takes time. Rushing the process or cutting corners will lead to incomplete purification and you risk developing illness from drinking it.

We strongly recommend two complimentary methods be used based on your water contamination estimation.

Basic water contaminants

Pathogens: Viral, bacterial, cysts, parasites, algae, nematodes
Organic and nonorganic chemicals, toxins, pesticides, petroleum, radiological, metals, arsenic

Methods of treatment

Heat.

Heat kills bacteria, viruses, cysts, nematodes, and parasites. Volatile chemicals may also evaporate.

In low human use areas 70°C (158°F) is adequate. This temperature can be reached at any elevation on earth.

HEP A is a heat resistant virus, so above 2000 ft. it needs a longer boil time. 10 mins up to 14,000 ft. elevation will work. This 10-min time usually happens in heat up and cool down cycle regardless in the field.

While pathogens like botulism take 110°C (230°F) for 10 min to treat and require a pressure cooker, it is not a common water contaminant we need to treat for in most circumstances.

You may use solar cookers to pasteurize water to 60°C (140°F)for 10 min or 30 min for HEP A (one study).

Use a thermometer or a wax gauge (WAPI) as a guide.

- 60°C = 140°F. 70°C = 158°F. 100°C = 212°F.

Elevation	5000 ft	10,000 ft	15,000 ft	20,000 ft
Boiling Temperature	95°C/203°F	90°C/194°F	85°C/185°F	80°C/176F

WAPI beige wax melts at 6 min at 69°C/156°F green is at 65°C/149°F. Reuse indefinitely.

Due to the time needed to boil water in the field, as soon as bubbles form you can cover the water and set it aside to cool and you have more than adequately treated all but the most extreme rare pathogens at any elevation where you would find them.

Pressure cookers reduce fuel use at all elevations.

Filtration.

Different types of filters include: ceramic, reverse osmosis, carbon, nanotubes, improvised cloth/sand type, pump and gravity – they come in all shapes and sizes and are available from camping and fishing shops through to homeware shops, or as a DIY project. The important point to understand regardless of the type you choose is the size and functionality of the filter.

They filter out bacteria, parasites, nematodes, algae and cysts. Filters in our opinion are not entirely reliable on viruses in the real world, regardless of manufacturer claims.

Silver filters and iodine resin are not reliable based on studies. Hollow fiber tube designs are cheap to make however, plastic in tubes have a shelf life as all plastic do, they clog and back flushing only restores partial flow, there is no quality control if a tubule breaks. GAC (granulated activated charcoal) or wood charcoal can assist with metals, radiological isotopes, pesticides, halogen and arsenic reduction.

Pre-filter with coffee filters wrapped around the inlet or cloth, pre-settling or flocculation (letting smaller contaminant material clump together) all help extend the life of the filter.

Filters of all types can freeze and crack. If using outside in the winter, keep them in a bag on you under your parka always.

Use filters with UV or chemical methods combined where possible.

We recommend ceramic filters. Specifically, we recommend the Katadyn pocket micro filter or expedition for when you are traveling and Black Berkey elements for when you are stationary.

Berkey elements can be placed in an elevated bucket and gravity flowed with surgical tubing to a lower container without all the other container expenses. Berkey elements must be pressure filled initially with a tap or pump for best results. Katadyn makes a similar product.

We do not recommend the straw type filters or pleated paper filters in general due to short lifespan and mold on filter issues – however there is some utility for a short-term solution.

Flocculation

This method involves using alum, bentonite or white fire ash to bind to contaminants in water and remove them. They can also separate algae from water reducing halogen demand. This alone does not purify water, but helps as a pretreatment for other methods.

Use 1 pinch of the powdered material per gallon of water and shake hard for 1 minute. Then use a gentle rocking motion for 5-30 minutes. Let the water sit for 1 hour to settle the solids then carefully pour off the top clear water through a paper or coarse cloth filter. You may also add granular activated charcoal or GAC as a pretreatment and coarse filter the water if available. Flocculation alone can remove 60% to 90% of pathogens.

Halogens

Halogens are a group of chemicals which include iodine or chlorine agents. They purify water by killing bacteria, viruses and other pathogens in the water. After adding the halogen to the water, a certain amount of time is required for the chemical to work. Note: 1ppm =1mg/l

Iodine. Iodine tablets are classically sold as "Water Purification" tablets. They often color or cloud the water which is being treated. Iodine tabs have a short 6 mon. shelf life once the package is opened.

Per liter of water with Iodine tabs (which go under a variety of tradenames and subtly different concentrations <purchase specific water purification tablets>) to achieve the following concentrations of free iodine you need:

4 ppm (for clean water) – ½ tab **8 ppm (for possible contaminated water) – 1 tab**

These tablets should be gunmetal grey in color when used – if rust colored they are useless: The free iodine has combined with atmospheric moisture. The bottles should be kept well sealed and replaced often.

Iodine in other formulations can be used for water purification:

2% iodine (tincture of Iodine). 4 ppm – 0.2 ml (5 drops/gtts) 8 ppm – 0.4 ml (10 gtts)

10% povidone-iodine (Betadine) solution only, NOT SCRUB	4 ppm - 0.35 ml (8 gtts)	8 ppm – 0.7ml (16 gtts)
Saturated iodine crystals	4 ppm – 13 ml	8 ppm – 26 ml
Iodine crystals in alcohol	0.1 ml / 5 ppm	0.2 ml / 10 ppm
Halazone tablets	4 ppm – 2 tabs	8 ppm – 4 tabs

For very cold water contact time should be increased.

If drinking this water after disinfection, flavoring agents (drink mixes, etc.) can be added: This must be done AFTER the period allocated for disinfection (the disinfecting agent will bind to the organic material and not work). This can also be added to water treated with chlorine (see below) if the taste of the water is too unpleasant.

Treatment time for iodine at 8ppm: 30 min at 5°C/41°F or 15 min at15°C/59°F. If the water is cloudy, double the time. If using a lower concentration than 8ppm, allow for more contact time.

An easy method of using iodine to treat water: Fill a 1l Nalgene bottle with water, then add 4 drops of 10% iodine (Betadine). A half hour later it's ready to drink. You may add a small amount of Vitamin C (50mg) to the water AFTER the 30 minutes' contact time. This will render the water virtually flavorless!

Calcium hypochlorite HTH or 'Pool shock'. The powder stores well but is highly caustic. Store in a well-ventilated space or completely sealed container

Make a solution. Always use solution within a month and check free chlorine and pH with pool test strips if available as treating the water. The effect of halogens can be highly variable in effect due to temperature, pH, types of pathogen, and level of organic matter content of the water.

It should be combined with filtration or at least flocculation and coarse filtration if contaminated source water.

Goal is 4ppm for 30 to 60 min. Cryptosporidium is quite resistant and 6-8ppm is recommended or longer contact times when it is suspected. Viruses can be harder to kill than bacteria.

Chlorine leaves a residual treatment effect so it is a good agent if the water is for storage.

6-8ppm smells and can cause GI issues when consumed if you are not used to it.

Make sure it can off-gas in an open container prior to consumption for 12 to 24 hours.

Concentrations of 0.5-2ppm is bacteriostatic and ideal for consumption. Most common failure is the lack of wait times.

Chlorine dioxide and iodine not recommend in pregnancy. Chlorine dioxide kills cryptosporidium but leaves residual fetal toxins. Iodine is picked up by fetal thyroid and with prolonged use can cause issues.

Household bleach is ok, but the risk is inconsistent strength due to short shelf life – with the concentration falling as time passes.

Treatment time with halogens is very dependent on dose and temperature – with a longer contact time required for cold water

Chlorine parts per million	• 5°C/41°F	15°C/59°F	30°C/86°F
• 2ppm	240 min	180 min	60 min
• 4ppm	180 min	60 min	45 min
• 8ppm.	60 min	30 min	15 min

Using 70% HTH ™ calcium hypochlorite take 14 grams or one heaped up tablespoon and mix into a paste. Then mix into 1 liter or water. This makes a 1% solution. For this purpose, as 3.8l=4qt, so quarts and liters are close enough to interchange and still get good water results.

Of the 1% solution, use:
8 drops per gallon (4.5l)
4 drops for a 2-liter soda bottle.
one and a half tbs. or about 27-28 ml for 55 gal.

Always confirm dose with test strips if available.

It is important to remember that the cloudiness of the water does not determine the amount of solution needed to purify the water. Rather, the amount of organic material (compounds derived from living organisms) present in the water source is what's important for determining how much of a halogen is needed. If you are unsure of how contaminated the water is, treat for the highest level of contamination to be safe.

Halogen demand variability examples	
Columbia river water	3-4mg/L
10% sewage water	2mg/L
Sand and clay filled brown Colorado river water	0.3mg/L
Municipal waste	20-30mg/L
Water sheads in western Oregon	0.4-1.6mg/L
Lily pond water	5-6mg/L

MIOX – mixed oxidant solution.

MIOX is made by the process of electrolysis – running a current of electricity between a positive and negative electrode in a solution of salt and water to produce free chlorine. It is a simple process, and there is some evidence to suggest the solution that is produced is more effective than calcium hypochlorite. MIOX also kills cryptosporidium. The problem is, it requires a consistent salt solution and power. It is potentially expensive.

SE200 Community Water Purifier is produced by MSR which utilizers the MIOX principle. Within a few minutes, it produces enough chlorine to treat 2000 liters of water and is ideal for small communities. It utilizes water, salt and electricity to produce the chlorine and will operate on mains or battery.

SE200 Community Water Purifier

Pregnancy. Calcium hypochlorite(HTH ™ pool shock) and MIOX (mixed oxidant solution) are are ok in pregnancy. Iodine should be used for very short term only emergently and chlorine dioxide should not be used at all in pregnancy.

For all halogenated compounds:

-if you are in a hurry, double the dose and halve the contact time
-if you suspect the water is heavily contaminated, double the dose or double the contact time
-cold temperatures require longer treatment time

UV Light

UV light destroys DNA - pathogens cannot reproduce and hence infect. It has no lasting effect like halogens so not for long term water storage.

SODIS is a very useful method (between 35 degrees of the equator. And out to 45 degrees during the height if summer) and involves the use UV light and heat to disinfect the water. A standard plastic (PET) or glass soft drink bottle is filled with water – the bottle should be completely clear. The filled bottle is place directly in sunlight for a minimum of 6 hours over the peak of the day. In winter or in lower latitudes consideration should be given for treating for 2 sequential days. Following this, the water should be disinfected and safe to drink. Water being treated in this way should ideally be coarse filtered or flocculated prior to improve the effectiveness of the technique. It is simple and cheap and an ideal austere method if no halogens are available.

The Steripen is small handheld (hence portable) UV source which produces safe drinking water in 60-90 seconds – its effectiveness is improved as above with the use of clear water.

Summary:

Contaminant	Heat	Filtration in microns	Notes
Giardia	50-70°C ,10 min	6-10x5-8	Filtration halogen UV
E histolytica	50-70°C, 10 min	5-30	Filtration halogen UV
Nematode cysts, helminth eggs, larvae, cercariae	50-55°C	30-4x50-80 20x500 50x100	Filtration UV Medium to very high up to 50 x the normal halogen range for roundworm eggs
Cryptosporidium	70°C, 1 min 55°C, 20 min	2-6	Filtration UV miox resistant to calcium hypochlorite and iodine
E coli	55°C, 30 min 65°C, <1 min	0.5x3-8	Filtration Halogen UV
Salmonella, shigella	65°C, <1 min	0.5x2, 10x12	Filtration halogen UV
V cholerae	60°C, 10 min	0.3-0.6	Quality filtration halogen UV
Campylobacter	75°C ,3 min	0.5x2	Filtration halogen UV
Viruses not hep A	60°C, 20-40 min 70°C, 1 min	0.03	Halogen UV
Hep A	85-98°C, 1 min	0.03	Halogen UV
Cyanobacteria Blue green algae		5-10	Filtration

Preparation of Distilled Water:

Distilled water is the preferred type of water for use in autoclaves and pressure cookers for sterilisation. Sterile distilled water is also the preferred type to produce IV fluids, and wound cleaning, and irrigation. Distilled water is sterilised by boiling.

Options:

Snow and rain: Freshly fallen snow and rain are good sources if you are not in a city due to the high risk of contamination of city air. For snow use the top layer only. If you don't get to it right after it starts snowing, scrape off the top layer, and collect underlying layers avoiding the bottom layers. Once melted this can be considered the equivalent of distilled water.

S*treams, springs, and wells:* Most springs, streams, and all rivers in US are contaminated to varying degrees be it with commercial effluent, or natural mineral run-off, or animal faces. Being safe to drink – which many streams in wilderness areas are, is not the same as being nearly distilled in quality. The conditions in other countries vary but those close to the equator can host more lethal or harmful organisms due to environmental factors. Wells are usually relatively uncontaminated with micro-organisms but they frequently will have a high mineral content and should be distilled before use in a pressure cooker.

Filtration: Commercial water filters do not produce pure distilled quality water but it is close; depending on the type of filter they remove bacteria, viruses, parasites, heavy metals, and some other chemicals. Ceramic water filters can be scrubbed and reused and are preferred.

Distilling water: The simplest method for distilling water is using the FEMA method. A large pot with a lid is filled 1/3 to 1/2 full of water. The lid is inverted and a coat hanger or wire is used to suspend a right side up coffee cup under the inverted handle. Steam collects on the pot lid and drips down the handle into the coffee cup when the pot is boiled. Let it cool and collect the distilled water in the cup. The less water boiled the less fuel used, but the closer the pot must be watched.

Appendix 2: Pharmacology

In this section, we provide a brief overview of common useful drugs in an austere or survival setting. There are thousands of different drugs, and they all have different uses and pros and cons to their use. It is not practical or possible to store more than a dozen to a couple of dozen different drugs – the cost of rotation when they expire (even if you are prepared to use beyond their expiry date to a certain degree) is prohibitive and so is the ability of the average person to obtain a large collection in the first place.

We have focused on a small set of common and useful drugs (about 50). As has been discussed elsewhere in this book most common medical problems can be dealt with, with a relatively small group of drugs and we have focused on these. They are divided into: "Antibiotics" and "Other Drugs".

Pharmacology is the study of drugs and how they work. We break it down further into pharmacodynamics (what the drug does to the body – what it does and how it works) and pharmacokinetics (what the body does to the drug – how it metabolises it, breaks it down and gets rid of it).

This is a complex field and we have not gone into huge detail for each drug. The goal is to provide enough information to give you a working knowledge – we have kept descriptions of the pharmacokinetic and dynamics simple and only included the common side-effects and important contraindications.

We have followed the same format providing similar information for each drug:

- Name (and route of administration)
- Class (type of drug it is)
- Pharmacokinetics
- Pharmacodynamics
- Indications (when to give it)
- Dosing
- Contraindications and cautions (when not to give it or when to be careful)
- Side-effects (the problems you sometimes see when you give it)
- Austere production potential **

** Austere production potential: This section does not detail the exact methods for manufacture – this would be a book in its own right. It is an indication of the complexity of manufacture and how practical production in an austere or survival situation is. Even those drugs which are relatively easy to manufacture would require knowledge of basic chemistry, laboratory equipment, and potentially pre-cursor chemicals. But we have flagged them as drugs with genuine potential for low-tech manufacture.

Part 1: Antimicrobials

An overview of antibiotics, their families and the bacteria they are most effective against is also provided in Chapter 8 – Infectious Disease and Antibiotics.

1. Penicillin V Potassium (tablets) / Penicillin G (injection):

Class: the classical penicillin class antibiotic. On the WHO List of Essential Medications.

Pharmacodynamics: Bactericidal action against penicillin-sensitive microorganisms. Weakens the developing bacterial cell wall causing the death of the organism.

Pharmacokinetics: It is excreted through the kidneys with as much as 60-80% being excreted unchanged in crystalline form.

Indications: bacterial infections such as mild to moderate pneumonia, scarlet fever, and skin, ear and strep throat infections. It is the drug of choice for non-bioterrorism related anthrax infections.

Dosages:

> **Oral**: Penicillin V Adults – 250 mg (400,000 units) or 500 mg (800,000 units) orally every 4 – 6 hours. May be taken with food but blood levels achieved are slightly higher if taken on an empty stomach.
> **IV**: Penicillin G 1.2gm (1.2 mega units) IV every 6 hours.

Contraindications: Known allergy to penicillin. True anaphylactic reactions to penicillin are rare.

Common Side Effects: Nausea, vomiting, epigastric distress or diarrhea. Mild rash is not a true allergic reaction. Can inactivate oral contraceptives during use.

Austere Production Potential: Potentially very good given the right knowledge and means of production. Penicillium chrysogenum produces approximately 50,000 times more medication per volume than the original Penicillium notatum strain the drug was developed from. Not all bread or fruit moulds are penicillium, and of those that are, not all are the correct strain.

2. Ampicillin (tablets or injection)

N.B. Ampicillin and Amoxicillin are essentially the same. Amoxicillin is slightly more lipid soluble and kills bacteria marginally faster than Ampicillin. They both also have a subtly different mechanism of action. They can be used and are often discussed inter-changeably.

Class: Penicillin class antibiotic, semi-synthetic derivative of penicillin. On the WHO List of Essential Medications.

Pharmacodynamics: Bactericidal activity by inhibition of cell wall synthesis.
Effective against gram-positive (usually) and gram-negative (lesser) aerobic and anaerobic bacteria. Has no effect on viral infections.

Pharmacokinetics: Excreted in the urine largely unchanged.

Indications: Gastrointestinal, genitourinary, bacterial meningitis, Salmonella and respiratory tract infections.

Dosages:

Usual dose: 500 mg by mouth taken 4 times daily for 7-14 days.
For respiratory infections: the usual dose is 250 mg taken orally 4 times daily.
For children: the usual dose is 100 mg/kg/day total, divided into 4 doses.
For respiratory issues in children: the usual dose is 50 mg/kg/day total taken in equal doses either 3 or 4 times daily.

Larger doses may be required for either children or adults for severe infections. This medication should be taken one hour before or two hours after meals.

Contraindications: Known hypersensitivity to penicillins.

Common Side Effects: Nausea, vomiting, diarrhea. Most reactions are related to sensitivity, more common in people with a history of asthma, hay fever or allergy. Anaphylaxis is rare, and is more common with injected rather than oral forms. Hypersensitivity reactions comprised of rash - which may cover the entire body and not start during the first week of administration - usually subsides after 3-7 days. It is described as erythematous, maculopapular, and/or mildly pruritic. First-line treatment for same consists of antihistamines.

Austere Production Potential: Limited due to the semi-synthetic nature of its manufacture.

3. Amoxycillin/Clavulanic Acid (tablets or injection) *(Augmentin ©)*

Class: Penicillin class antibiotic

Pharmacokinetics: Amoxicillin/clavulanic acid is mostly excreted in urine.
Clearance from the body is prolonged if the patient has significant renal impairment, but this does not alter the initial dose.

Pharmacodynamics: Amoxicillin/clavulanic acid is a beta-lactam antibiotic with broad activity against gram negative and gram positive bacteria. It also has some activity against anaerobic bacteria, particularly those from the mouth.

Amoxicillin is the active ingredient and is part of the penicillin-class of antibiotics. Amoxicillin stops the production of the bacterial cell wall, causing bacteria to die.

Many bacteria are resistant to amoxicillin due to their ability to produce beta-lactamase (an enzyme) which destroys the active part of beta-lactam antibiotics. Clavulanic acid inhibits the beta-lactamase enzyme and has no direct antibacterial action.

Indications: Moderate to severe respiratory infections. Useful also for abdominal infection and peritonitis if no alternatives are available. Second line agent for skin and urinary tract infections.

Dosages:

Oral: 625mg tablet three times per day
IV: 1.2gms intravenously three times per day

Contraindications: Known severe penicillin allergy. Up to 10% of the population claim to have a penicillin allergy, but only approximately 1% will have a clinically significant allergy and amoxicillin/clavulanic acid should be administered unless the allergy is clearly severe.
.
Common Side Effects: None. Amoxicillin/clavulanic acid can cause diarrhea and vaginal thrush following a course of it due to alteration in the normal bacteria of the body.

Austere production potential. Poor due to its complicated production

4. Flucloxacillin (tablets or injection)

Class: antibiotic of the penicillin class but considered to be narrow spectrum in nature. Unlike other penicillin's it does attack beta-lactamase-producing organism like Staph Aureus, but is ineffective against MRSA. Gram positive in action.

Pharmacodynamics: Action prevents synthesis of bacterial cell walls, causing them to break down.

Pharmacokinetics: Metabolized in the liver, however the route of elimination is not listed.

Indications: skin and soft tissue infections such as cellulitis, boils and abscesses, respiratory tract infections such as pneumonia, tonsillitis, quinsy, and middle and outer ear infections. May also be useful for osteomyelitis, urinary tract infection, meningitis and septicemia.

Dosages:

Adults: 250 mg orally 4 times daily
Osteomyelitis: Up to 8 grams daily in equal divided doses every 6 or 8 hours per preference
Children: Age 2 and over – 1/2 of adult dose
Under age 2 – 1/4 of adult dose

Contraindications: Known allergy to penicillins, cephalosporins or carbapenams. Use with caution in the elderly, and in those with hepatic impairment.

Common Side Effects: Commonly minor GI distress; rash, urticarial and purpura are uncommon.

Austere Production Potential: likely complicated well beyond normal penicillin production.

5. Probenecid (tablet)

Class: Prototypical uricosuric agent, often used as an adjunct to antibiotic therapy, and as an anti-gout agent.

Pharmacodynamics: Inhibits the tubular reabsorption of urate, which in turn causes increased uric acid excretion causing a decrease in serum (blood) urate levels. It also effectively inhibits the excretion of and some β-lactam antibiotics, penicillins in general, and most cephalosporins. Other medications which it reportedly inhibits the excretion of include captopril, indomethacin, NSAIDS such as naproxen, toradol (keptoprofen) and ketorolac. Aspirin, however, may reduce the action of Probenicid by way of an unknown mechanism. Other medications which it inhibits the excretion of include quinolone antibiotics, methotrexate, lorazepam, and acyclovir.

Pharmacokinetics: Metabolic mechanism not available. Excreted through the kidneys.

Indications: Adjunct to certain antibiotic therapy to increase the effectiveness of the antibiotic and thereby also extend the supply.

Dosage:

500 mg by mouth 4 times daily when used as an antibiotic adjunct.

Contraindications: known allergy. Severe allergic reaction is reported to be rare. Alcohol intake can lessen the drug's effectiveness.

Common Side Effects: Headache, dizziness, nausea, vomiting, renal colic, flushing, loss of appetite, sore gums, frequent urination

Austere Production Potential: Very unlikely

6. Ceftriaxone (injection)

Class: Semisynthetic Cephalosporin antibiotic with broad spectrum activity. On WHO List of Essential Medicines.

Pharmacodynamics: Bactericidal, inhibits mucopeptide synthesis in the bacterial cell wall, eventually resulting in the formation of defective cell walls and bacterial death. Has in vitro activity against Gram-positive and Gram-negative aerobic and anaerobic bacteria.

Pharmacokinetics: metabolism is not available. 1/3 to 2/3 of drug is found excreted in the urine unchanged, with remainder excreted through bile via feces.

Indications: Community-acquired pneumonia, lower respiratory tract infection, bacterial sepsis, bacterial meningitis, shigellosis, syphilis, middle ear infections, endocarditis, pelvic inflammatory disease and skin and skin structure infections and bone and joint infection.

Dosages:

May administered via IM or IV routes only. Dose and duration varies by nature of infections and severity of same. Dosages vary widely based on infection being treated. Consult a competent drug reference. Following are general examples only:

Special Note: For IM injection Ceftriaxone (Rocephin) is frequently diluted with 1% Lidocaine instead of sterile water or saline. Consult package insert or competent drug reference for directions.

Bacteraemia: 1 – 2 Gram daily as a single dose, or twice daily in equally divided dose for 4 – 14 days (minimum 2 days beyond cessation of symptoms). Do not exceed 4 gram daily.
Gonococcal Infection: Uncomplicated: 250 mg IM one time
Bacterial Meningitis: 4 Gram IV every 24 hours wither as a single dose or divided into 2 equal doses every 12 hours for 7 - 21 days. Infectious Diseases Society of America (IDSA) recommendation.
PID due to N gonorrhoeae: 250 mg IM as a single dose.
Bronchitis: 1 – 2 gram IV or IM daily for 4 - 14 days. Longer therapy may be required for complicated infections.
Surgical Prophylaxis: 1 gram IV given as a single dose 30 to 120 minutes prior to surgery.
Endocarditis: 2 gram IV or IM every 24 hours for 4 weeks. In the presence of native implanted valve, or 6 weeks for artificial valve.

Contraindications: A number of drug interactions, including Probenicid (beneficial) , and Warfarin and Calcium Carbonate (non-beneficial). When treating PID, it has no activity against Chlamydia trachomatis. Most strains of C. dif also show no response to Cephalosporins. Never mix with diluents/IV fluids containing calcium (Ringer's, Hartmann's Solution) as particle formation can occur. Not recommended in patients with history of true anaphylactic reaction to penicillin, but with milder reactions (rash, etc), its use is probably ok.

Common Side Effects: Most common is warmth, tightness or induration at the injection site following IM administration (17% of cases), then loose stools (2.7%) and hypersensitivity manifested as rash (1.7%). Fever, chills, nausea and dizziness have also been reported.

Austere Production Potential: Potentially good. Several processes for improvised preparation exist. See Process for the Preparation of Ceftriaxone (patent) US 5026843 A for an example. Potential issues with precursor agents availability.

7. Cephalexin (tablet)

Class: Second generation cephalosporin antibiotic. On the WHO List of Essential Medications.

Pharmacodynamics: Effective against most Gram-positive bacteria and many Gram-negative microorganisms. Inhibits cell wall synthesis.

Pharmacokinetics: filtered out by the kidneys and excreted unchanged

Indications: Bone, genitourinary and respiratory, skin and subcutaneous tissue infections, and acute prostatitis.

Dosages:

Usual dose for all applications is 250 mg every 6 hours by mouth, but may also be taken as 500 mg every 12 hours, normally for 7 to 14 days. Pediatric dosing is considered weight-dependent. May be given without regard to meals.

Contraindications: Known hypersensitivity to cephalosporins. Should not be administered with Probenicid.

Common Side Effects: Most common is diarrhea, followed by nausea and vomiting. Rash and fever may occur. Allergy seen in less than 0.1% of patients, but rises to 1 – 10% of patients with penicillin allergy.

Austere Production Potential: Unlikely owing to complexity.

8. Tetracycline (tablet)

Class: Tetracycline antibiotic, classified as broad-spectrum. On the WHO List of Essential Medications.

Pharmacodynamics: Bacteriostatic, prevents replication and growth of the infecting microorganisms by interfering with protein synthesis.

Pharmacokinetics: Absorption takes place primarily in the stomach, duodenum and small intestine. Forms non-dissolvable complexes in the presence of calcium, magnesium, iron and aluminum. Meals of protein, fat or carbohydrate with reduce absorption by up to 50%; best taken on an empty stomach – either 1 hour before or 2 hours after meals - for that reason. Mostly excreted by the kidney and biliary routes. Must take with at least 8 ounces of fluids for bedtime dose. Do not take with oral contraceptives.

Indications: Indicated for bacterial infections involving the skin, respiratory and urinary tracts, intestines, genitalia and other systems. It does not treat viral infections. Occasionally used when other medications such as penicillin and others cannot be safely used for a particular patient.

Dosages:

500 mg taken by mouth every 6 hours for 7-21 days depending on infection being treated. Longer course of treatment for anthrax. Only taken twice daily for skin infections.

Common Side Effects: Nausea and vomiting, diarrhea, greatly increased skin sensitivity to sunlight.

Austere Production Potential: Good, assuming possession of the right knowledge and means. Not a cottage-level endeavor but possible in a non-modern setting.

9. Doxycycline (tablets)

Class: tetracycline antibiotic. On the WHO List of Essential Medications.

Pharmacodynamics: Bacteriostatic. Inhibits protein production, thus causing the death of affected microorganisms.

Pharmacokinetics: Concentrated in the liver by bile and expelled via urine and feces.

Indications: Effective against a broad range of both Gram-positive and Gram-negative and some anaerobic bacteria. Indications may include Rocky Mountain spotted and typhoid fevers, plague, tularemia, brucellosis, c diff, uncomplicated gonorrhea and syphilis. It is a recommended first-line antibiotic choice for suspected bioterrorism related anthrax infection if Ciprofloxacin is not available.

Dosages:

Usual dose for most indications is 100 mg every 12 hours the first day, followed by either 100 mg taken once daily, or 50 mg taken twice daily.

For inhalational anthrax, the dose is 100 mg twice daily for 60 days. Some indications will vary widely and the dosing should be closely compared to the presumed infection.

Contraindications: Known sensitivity to any of the Tetracycline family of medications.

Common Side Effects: Significantly increased risk of sunburn during usage, nausea, chest pain or heartburn, blood in urine or stools, difficulty breathing, visual disturbances including color differentiation.

Austere Production Potential: Unknown though believed to be adaptable to 1960's-level pharm technology but we have been unable to source a clear chemical process.

10. Clindamycin (tablets or injection)

Class: Is a stand-alone class antibiotic. On the WHO List of Essential Medications.

Pharmacodynamics: May be either bacteriostatic or bactericidal depending on the organism and the concentration of the drug. Works by blocking protein production. Clindamycin is unique drug in that the blood concentration achieved taking a tablet is very like that obtained intravenously – a high oral bioavailability.

Pharmacokinetics: Metabolized by the liver, expelled more by way of urine than feces.

Indications: Has anti-anaerobic and anti-protozoal properties. Most effective against aerobic Gram-positive cocci, and anaerobic, Gram-negative rod-shaped bacteria. Many aerobic Gram-negative bacteria are resistant to this drug. except for Capnocytophaga canimorsus, for which it is a first-line medication. C. canimorsus is common in the mouths of both cats and dogs and other carnivores so is useful for

animal bites. It can be found in oral, intravenous and topical forms. It is often reserved for use in patients who should not be given Penicillin due to allergy.

Dosages:

Varies widely and should be determined by a competent drug guide combined with clinical judgment. Usual adult dose is 150 to 300 mg by mouth every 6 hours, and 300 to 450 mg every 6 hours for more severe infection.

Contraindications: Known hypersensitivity to either Clindamycin or Lincomycin.

Common Side Effects: Mild to moderate skin rashes are the most common adverse reaction. Other common reactions include nausea and vomiting. Puritis and vaginitis have been reported. Clindamycin is known to cause C. difficile infection at a rate nearly 4 times that of other antibiotics. Use with greater caution in people over 60 years of age and patients with a history of gastrointestinal disease such as colitis.

Austere Production Potential: Indeterminate – likely difficult to produce.

11. Ciprofloxacin (tablet or injection)

Class – Broad spectrum quinolone antibiotic. On the WHO List of Essential Medications.

Pharmacodynamics: Bacteriocidal; inhibits essential enzymes required for bacterial reproduction, repair, and recombination. Like clindamycin has a high oral bioavailability.

Pharmacokinetics: Readily absorbed by the GI tract. Metabolized primarily by the liver with additional removal by the kidneys.

Indications: Fluoroquinolone class, broad spectrum activity against Gram + and Gram – microorganisms. Effective against organisms that are resistant to other classes of anti-infectives but also faces increasing resistance from a range of infections. Recommended first-line antibiotic choice for suspected bioterrorism related anthrax infection. Respiratory, urinary tract, abdominal and gastrointestinal infections.

Dosages:

In oral form, the usual dose is 500 mg by mouth every 12 hours. Consult a competent drug handbook for illness-specific dosing. Dosing is higher, for instance, in treatment of plague and lower for urinary tract infection. For anthrax treatment, the course is for 60 days' duration.

Contraindications: Epilepsy or other seizure disorder, persons taking Tizanidine (a muscle relaxant), known sensitivity to fluoroquinolones, pregnancy and nursing mothers. Not for routine use in children.

Common Side Effects: Increased tendency towards Achilles tendon rupture (0.1%), nausea, vomiting, diarrhea and rash.

Austere Production Potential: Very poor. Requires modern pharmacology production techniques.

12. Levofloxacin (tablet)

Class: Broad spectrum quinolone antibiotic. On the WHO List of Essential Medications.

Pharmacodynamics: Bactericidal. Inhibits bacterial cell division. Has strong Gram positive effects, but is weaker than Cipro against Gram negative organisms, especially Pseudomonas aeruginosa. Considered to be effective against most strains of bacterial that cause respiratory, gastrointestinal, genitourinary and abdominal infections.

Pharmacokinetics: Intravenous and oral preparations of this medication are interchangeable as far as effectiveness – i.e. it has a very high oral bioavailability. Excreted in the urine.

Indications: Often included along with Azithromycin in pneumonia protocols. Indications include community-acquired pneumonia, chronic bronchitis, complicated urinary tract infections, skin and skin structure infections (cellulitis), plague, diverticulitis, postoperative wound infections and others.

Dosages:

Community acquired pneumonia: 500 mg daily for 7-14 days or 750 mg daily for 5 days;
Nosocomial (hospital-acquired) pneumonia: 750 mg daily for 7-14 days;
Complicated skin/structure infections: 750 daily for 7-14 days;
Uncomplicated UTI: 250 daily for 3 days;

Contraindications: Known history of Myasthenia Gravis. Administration in patients also receiving antacids, Sulcrulfate and multi-vitamins can produce reduced absorption resulting in lower blood levels of the medication. Can also interfere with effects of anti-diabetic agents.

Side Effects: Fluoroquinolones, which includes Levofloxacin, are associated with increased risk of tendonitis and Achilles tendon rupture in all age groups, but most notably in people over 60 years of age and those taking corticosteroid medications.

Common Side Effects: Include nausea, diarrhea, increased sunburn risk, trouble sleeping

Austere Production Potential: Very poor owing to the entirely synthetic nature.

13. Cotrimoxazole/SMZ-TMP/*Bactrim* (tablet)

Class: Sulfonilamide class sulphur antibiotic. On the WHO List of Essential Medications.

Pharmacodynamics: Combination of antimicrobial and antibacterial activity. Affects cellular folate production in protozoa, fungi and bacteria. Primarily effective against Gram negative infections. Very little effect against Gram positive infections (streptococcal infections are an exception).

Pharmacokinetics: Metabolized by the liver and excreted through the kidneys.

Indications: Urinary tract infections including pyelonephritis and cystitis, otitis media, plague, pertussis and others.

Dosages:

Available in strengths of 400/80 mg and 800/120 mg (double strength, or DS). Normal adult dosing is 800/160 mg orally every 12 hours, consult a competent reference for other dosing as indicated. Pediatric dosing is by weight.

Contraindications: Can result in increased blood levels of Digoxin if used in patients taking same. Do not use in elderly patients who are also receiving diuretics. Sulfonamides – including Bactrim – should be immediately discontinued at the first sign of any rash or other sign of adverse reaction. Do not use in pregnancy.

Common Side Effects: Loss of appetite, nausea, vomiting, tiredness or insomnia, ringing in the ears

Austere Production Potential: Unknown.

14. Erythromycin (tablet or injection)

Class: Macrolide antibiotic. On the WHO List of Essential Medications.

Pharmacodynamics: Inhibits bacterial protein synthesis. May be bactericidal or bacteriostatic depending on organism and drug concentration.

Pharmacokinetics: Extensively metabolized by the liver.

Indications: Mild to moderate upper respiratory tract infections, pertussis, diphtheria, may be effective against Legionnaire's disease, treatment of Chlamydia infections in adults when Tetracycline is not tolerated, and in cases of acute pelvic inflammatory disease and syphilis where the patient is allergic to Penicillin.

Dosages:

Typical dosing is 400 mg orally every 6 hours. Dose may be increased up to 4 grams/day in presence of severe infection. For streptococcal infections administration should continue for 10 days. For primary Syphilis or Legionnaire's, consult a competent drug reference for dosing.

Contraindications: can raise Digoxin levels in patients receiving same. May increase the effects of anticoagulant medications. Decreases clearance of Alprazolam from the system.

Common Side Effects: Nausea, vomiting, diarrhea, rash, mild itching, dizziness, tiredness. May worsen symptoms of myasthenia gravis where already present. Reversible deafness is not unknown but is rare.

Austere Production Potential: Reported to be better than average.

15. Azithromycin (Zithromax) (tablet)

Class: Semi-synthetic macrolide antibiotic, related to Erythromycin. On the WHO List of Essential Medications.

Pharmacodynamics: Bacteriostatic. Broad but shallow antibacterial activity. Inhibits some Gram positive and Gram negative, and many atypical bacteria by interfering with protein synthesis.

Pharmacokinetics: Metabolized in the liver. Biliary excretion (feces) is believed to be the primary route of expulsion. Absorption in greater if taken on an empty stomach.

Indications: Community-acquired pneumonia, uncomplicated skin infections, acute bacterial exacerbations of chronic obstructive pulmonary disease, otitis media, pharyngitis or tonsillitis, for treatment of gonorrhea in conjunction with Ceftriaxone, chancroid ulcer in men, bacterial sinusitis, conjunctivitis, and others.

Dosages:

Normal dosing for respiratory infection is 500 mg by mouth the first day, followed by 250 mg daily for days 2-5. Dosing for sexually transmitted diseases differs and should be guided by a competent drug reference. A single dose of 2gms is usually effective for gonorrhea.

Contraindications: Do not take antacids containing either aluminum or magnesium with this medication. Do not use if allergic to this or similar medications such as Erythromycin (EES) or Biaxin. Consult a competent drug reference to check for other potential drug interactions with this medication.

Common Side Effects: Headache, nausea, diarrhea, mild rash or itching.

Austere Production Potential: Unlikely to be possible to complicated nature of synthesis.

16. Chloramphenicol (tablet, injection or eye ointment)

Class: antibiotic, classified as broad spectrum. Effective against many Gram + and Gram – as well as anaerobic infections, and some rickettsia. On the WHO List of Essential Medications.

Pharmacodynamics: mainly bacteriostatic by way of prohibiting protein synthesis, but also possesses some bactericidal properties.

Pharmacokinetics: 90% metabolized in the liver.

Indications: Broad spectrum indications, including cholera; effective against the 3 main causes of bacterial meningitis. Increasing resistance by some microorganisms has been observed.

Dosages:

Based on body weight. For adults and teenagers usual dose is 12.5 mg/Kg (5.7 mg/pound) every 6 hours. It is provided in either 250 mg capsules or 125 mg/5 ml liquid forms. It is not available inside the United States.

Contraindications: Known sensitivity, concurrent use of immunosuppressant agents,

Common Side Effects: Diarrhea, nausea and vomiting, sore throat, fever, unusual tiredness or fatigue. Bone marrow damage can occur, and can result in aplastic anemia which can be fatal. The ophthalmic and oral forms seem to have a much greater incidence rate compared to the IV form.

Austere Production Potential: Very good potential for low-tech production given the means and knowledge.

17. Metronidazole (tablet or injection)

Class: Antibiotic and antiprotozoal. On the WHO List of Essential Medications.

Pharmacodynamics: Affects primarily anaerobic bacteria with little effect on aerobic bacteria by the inhibition of nucleic acid synthesis.

Pharmacokinetics: Excreted through the urine.

Indications: Bacterial vaginosis, periodontal disease, intra-abdominal infections, aspiration pneumonia, lung abscess, giardiasis,

Dosages:

Trichomoniasis: 2 grams given as a divided dose on Day 1, followed by 250 mg dose 3 times daily for 7 days.
Acute amebic dysentery: 750 mg given 3 times a day for 5 – 10 days.
Acute bacterial infection: 500 mg orally every 6 hours for 7-10 days.
Bacterial vaginosis: 750 mg orally daily for 7 days.
Giardiasis: 250 mg orally 3 times daily for 7 days.
Soft tissue or skin infections: 500 mg orally every 6 hours for 7 – 10 days.

Contraindications: Stevens–Johnson syndrome is reported at a high rate when this medication is used concurrently with Mebendazole. Alcohol intake should be halted and remain so for at least 3 days following completing the medication course due to increased gastric effects – including severe nausea and vomiting, and the sensation of a severe hangover.

Common Side Effects: Most common (less than 1% occurrence rate) are nausea, vomiting, abdominal pain, weight loss, diarrhea, and metallic taste in the mouth (common). Rash, itch, flushing and fever are reported to be uncommon.

Austere Production Potential: Cautiously recommended and production not overly complicated. U.S. Patent No. 2,944,061. Usual caveats apply.

18. Tinidazole (tablet)

Class: Antiprotozoal, antibacterial

Pharmacodynamics: Leads to cell death by DNA damage after first binding to the targeted cells. Effective against most anaerobic protozoa. In addition, some Gram-negative anaerobic bacteria and Gram-positive anaerobic bacteria respond well to this medication.

Pharmacokinetics: Significant metabolic conversion takes place in the liver. Approximately 12% of the drug is excreted via feces, the remainder via urine.

Indications: Amoebic and parasitic infections such as Trichomoniasis, Giardiasis, intestinal amebiasis and amebic liver abscess. Ulcerative Gingivitis also responds well to a single dose.

Dosages:

Trichomoniasis: 2 grams orally taken once by both partners
Giardiasis: 2 grams orally taken once
Amebiasis : 2 grams orally taken daily for 3 days
Ulcerative Gingivitis: 2 grams taken once. If active dental intervention is not possible medication may be taken as 2 grams daily for 3 days' total to achieve maximum result.

Contraindications: Known sensitivity to nitromidazole compounds such as Tinidazole and Metronidazole. Alcohol should be avoided during the course of the medication and for 3 days after competing same. It crosses the placental barrier and is secreted in breast milk.

Common Side Effects: Nausea, vomiting, lack of appetite, metallic taste in the mouth. Tinidazole is generally believed to produce fewer side effects than Metronidazole, being better tolerated in the stomach.

Austere Production Potential: poor

19. Diflucan (tablet)

Class: Antifungal agent. On the WHO List of Essential Medications.

Pharmacodynamics: Affects cellular permeability. May also inhibit cellular respiration and biosynthesis.

Pharmacokinetics: Metabolized by the liver and excreted in the urine largely as an unchanged drug

Indications: Candida-induced infections including vaginal, cryptococcal meningitis and pneumonia, and other fungal infections.

Dosages:

Vaginal Candidiasis: single 150 mg dose.
Oropharyngeal and Esophageal Candidiasis: 200 initial dose, followed by 100 mg daily for 2 weeks.

Contraindications: Very long list of potential drug interactions, including Acetominophen (Paracetamol). Consult a competent reference if patient is already on multiple medications.

Common Side Effects: Most common side effects are headache (13%), nausea (7%) and stomach pain (6%). Angioedema and anaphylaxis are incidents are rare.

Austere Production Potential: Very good with the proper equipment, knowledge and preparation. See US Patent US 5508423 A.

20. Ivermectin (tablet)

Class: Antihelminthic. On the WHO List of Essential Medications.

Pharmacodynamics: Anti-parasitic agent used in deworming. Affects cell membrane permeability, leading to paralysis and death of the parasites.

Pharmacokinetics: Metabolized in the liver, excreted almost exclusively in the feces over a 12-day period.

Indications: Scabies, head lice, River Blindness/onchocerciasis (Central and South America and sub-Saharan Africa) due to parasitic worm infection, nematode (roundworm) infection, Strongyloidiasis (mainly tropical and sub-tropical countries) caused by nematode (roundworm) infection.

Dosages:

Onchocerciasis: single dose totaling approximately 150 micrograms per Kg of body weight. May be repeated in as little as 3 months. Initial cure rate not available.
Strongyloidiasis: single dose totaling approximately 200 micrograms per Kg of body weight. Reported cure rate is 64 – 100% for single dose therapy. Absorption is reportedly increased if taken with a high fat meal.
Head Lice: 0.5% lotion applied for 10 minutes and removed.
Scabies: 200 micrograms per Kg for cases resistant to topical applications.

Contraindications: Known allergy to the medication. Approximately 376 known potential drug interactions affecting serum concentrations - consult a competent reference if patient is already on multiple medications.

Common side effects: Most common are puritis and dizziness, affecting less than 3% of patients. Other side effects include nausea and diarrhea (below 2%), and vomiting, rash or constipation (below 1%).

Austere Production Potential: Unknown.

21. Mebendazole (tablet)

Class: Broad-spectrum anthelmintic. On the WHO List of Essential Medications.

Pharmacodynamics: Inhibits carbohydrate metabolism by the parasites, causing death of the organism

Pharmacokinetics: Metabolized primarily by the liver and excreted more than 90% through feces

Indications: Whipworm, pinworm, common hookworm, American hookworm, and roundworm

Dosages:

Pinworm: 100 mg taken once
Whipworm: 100 mg twice daily for 3 days
Roundworm: 100 mg twice daily for 3 days
Hookworm: 100 mg twice daily for 3 days

Contraindications: Serum concentration of Acetaminophen (Paracetamol) can be increased with concurrent use. Approximately 255 known potential drug interactions. Safety during pregnancy not established. For use if patients age 2 or older

Common Side Effects: Most common are stomach pain, diarrhea, flatulence, and nausea and rash. Very rare potential side effects include Neutropenia and Stevens-Johnson Syndrome.

Austere Production Potential: Unknown

22. Albendazole (tablet)

Class: Broad-spectrum anthelmintic, anti-filarial. On the WHO List of Essential Medications.

Pharmacodynamics: Prevents growth of newly hatch insect larvae within the body by induced starvation of the parasite.

Pharmacokinetics: Metabolized by the liver and excreted by the biliary route. Very little urine excretion.

Indications: Flatworms (liver flukes in humans), nematodes, Giardia (inferred but not necessarily established), pork tapeworm, roundworm.

Dosages:

Pinworm: 400 mg orally taken once, repeat in 2 weeks
Hookworm: 400 mg orally taken once
Trichinosis: 400 mg orally twice daily for 8 -14 days
Whipworm: 400 mg orally daily for 3 days.

Dosages for unnamed infections should be determined on a case-by-case basis using a competent reference.

Contraindications: Potentially unsafe during pregnancy.

Common Side Effects: Stomach pain, nausea, headache, temporary hair loss.

Austere Production Potential: Possibly producible with 1970's technology.

23. Sulfamylon (Mafenide Acetate) (topical – for skin use)

Class: Sulfonamide-type topical antibiotic with antifungal properties.

Pharmacodynamics: Bacteriostatic, with broad action against many Gram negative and Gram positive organisms including Pseudomonas aeruginosa, Streptococcus, Clostridia, and some strains of aenerobes.

Pharmacokinetics: metabolites are excreted in urine. It is absorbed into systemic circulation even through burn eschar.

Indications: 2nd and 3rd degree burns confined to smaller areas rather than significant body percentages.

Dosages:

1.5 – 2.0 mm thickness over affected areas.

Contraindications: Known sensitivity to sulfonamides. Use with great caution in acute renal failure.

Common Side Effects: Metabolic acidosis is possible with this medication. Pain or burning sensation with application, rash, itching.

Austere Production Potential: Believed to be good. 1940's pharmaceutical technology.

24. Mupirocin (Bactroban) (topical - for skin use)

Class: Topical antibiotic.

Pharmacodynamics: Mostly effective against Gram positive bacteria. Regarded as bacteriostatic at low concentrations, and bactericidal at high concentrations. It employs a unique mechanism of action that blocks bacterial proteins; this mechanism is not shared with any other antibiotic. The result is that Mupirocin has very few antibiotic cross-resistance problems.

Pharmacokinetics: Metabolized in the liver and excreted through the kidneys.

Indications: Imeptigo, secondary skin infections, staph aureus (MRSA) colonization of the nasal passages. Can be used prophylactically by healthcare providers to prevent carrying of MRSA between patients.

Dosages:

Nasal formulation: Thin layer inside each nares twice daily for 5 days. Press nares together and release several times over a minute to help spread the medication. Normal course is 5 days.
Skin infection: Small amount applied to affected area 3 times daily for 10 days.
Impetigo: Small amount to affected area 3 times daily for 5 days and re-evaluate.

Contraindications: Known sensitivity.

Common Side Effects: Itching, burning or stinging of the nose, rhinorrhea, altered sense of taste.

Austere Production Potential: Unknown

25. Silver Sulfadiazine *(Silvadene, Flamazine)* (topical – for skin use)

Class: Sulphur-class antibiotic (topical). On the WHO List of Essential Medications.

Pharmacodynamics: Broad antimicrobial activity. Bactericidal for many Gram positive and Gram negative bacteria as well as being effective against yeasts. Acts on the cell wall and cell membrane. Silver itself is a biocide.

P**harmacokinetics**: systemically absorbed medication is excreted in the urine. It is poorly absorbed through the skin except when extensively applied to damaged skin.

Indications: 2nd and 3rd degree burns of the skin.

Dosages:

Applied as an approximately 1/16th inch (2 mm) to indicated area.

Contraindications: No reported drug interactions.

Common side effects: Localized argyria (permanent grey/blue discoloration of the skin) has been reported. Burning and painful sensations upon application have been reported but are temporary. Between 0.1% and 1% of people report hypersensitivity reactions such as rash.

Austere Production Potential: Excellent potential, though not to be confused with so-called colloidal silver preparations.

26. Clotrimazole (topical – for skin or vaginal use)

Class: Antifungal

Pharmacodynamics: Interferes with the biosynthesis of an important fungal cell membrane component, which increases permeability and causes disruption of the enzyme systems.

Pharmacokinetics: metabolized in the liver to inactive metabolites.

I**ndications**: Athlete's Foot, Tinea Infections, Ringworm, Yeast Infections, Cutaneous Candidiasis, Vaginal Candidiasis.

Dosages (Cream):

Athlete's Foot: Cover affected and immediately surrounding area with a thin layer twice daily for 4 to 8 weeks as needed.

Tinea Cruris: Cover affected and immediately surrounding area with a thin layer twice daily for 2 weeks.
Ringworm: Cover affected and immediately surrounding area with a thin layer twice daily for 4 weeks.
Vaginal Candidiasis: Cover affected and immediately surrounding area with a thin layer twice daily 2 times daily for 7 days.
Cutaneous Candidiasis (diaper rash): Cover affected and immediately surrounding area with a thin layer twice daily for 2 weeks.

Contraindications: Known allergy to medication. 780 known potential drug interactions including Acetaminophen and Aspirin. Consult a competent reference if patient is already on multiple medications.

Common Side Effects: Redness and burning are the most common

Austere Production Potential: Unknown

27. Nystatin (oral suspension)

Class: Antifungal agent with both fungistatic and fungicidal properties.

Pharmacodynamics: Alters cellular membrane permeability, causing subsequent leakage in susceptible species. Exhibits no appreciable activity against bacteria, protozoa or viruses.

Pharmacokinetics: Not absorbed through intact skin or mucous membrane. Clearance mechanism for oral dosing not available.

Indications: Oral Candidiasis (Thrush), cutaneous candida infections.

Dosages:

Generally available in 3 separate forms:
Cream: apply thin coating (1.5 – 2.0 mm) to affected areas 2 times daily until symptoms fully resolved. Powder is preferred for moist areas.
Powder: dust onto affected surface areas 2 – 3 times daily until symptoms fully resolved. Cream preferred for dry areas.
Oral Solution: 4 – 6 ml (400,000 – 600,000 units) taken 4 times daily for minimum of 48 hours after oral symptoms have disappeared. Swish fluid around in mouth and hold there as long as practical before swallowing.

Contraindications: Known allergy. 76 listed potential drug interactions including Diltiazem, Gabapentin, Lamotrigine, Pregabalin and Progesterone. Consult a competent reference if patient is already on multiple medications.

Common Side Effects: Less than 0.1% incidence including burning, itching, rash.

Austere Production Potential: Very good, assuming proper means and knowledge are available. Derived from naturally existing soil bacteria.

28. Terbinafine (tablet)

Class: Synthetic antifungal

Pharmacodynamics: Interferes with fungal cell wall synthesis.

Pharmacokinetics: Metabolized by the liver. Excretion pathway not stated.

Indications: Tinea unguium, also called onychomycosis (nail fungus).

Dosages:

Fingernail onychomycosis: 250 mg orally once daily for 6 weeks
Toenail onychomycosis: 250 mg orally once daily for 12 weeks

Contraindications: Chronic or active liver disease.

Common Side Effects: Most frequently reported side effects are headache, diarrhea and heartburn. In a very few cases serious side effects have been reported, including Stevens-Johnson Syndrome, liver failure and severe neutropenia.

Austere Production Potential: Not believed to be suitable for low tech production

29. Gelmicin *(Betamethasone Dipropionate, Clotrimazole, Gentamicin Sulfate)* (topical – for skin use)

Class: Combination topical preparation consisting of a Glucocorticoid, Antifungal and Antibiotic

Pharmacodynamics: Possessive of anti-inflammatory, antifungal and antibiotic properties.

Pharmacokinetics: very little systemic absorption.

Indications: Minor skin infections including cutaneous tinea infections, cutaneous inflammation secondary to surface wounds to the skin (including localized infection), ringworm, candidiasis, bacterial infection of the skin surface including the epidermis and dermis but not underlying layers

Dosages:

1.5 – 2.0 mm thick application 3 times daily until 2 days past resolution of all visible symptoms.

Contraindications: known allergy to any of the ingredients.

Common Side Effects: contact dermatitis, redness, burning sensation.

Austere Production Potential: given the proper equipment and knowledge believed to be cautiously feasible.

30. Neosporin (topical for skin use)

Class: topical combination antibiotic

Pharmacodynamics: Neomycin component interferes with RNA binding at receptor sites of affected cells. Polymyxin B component has a cationic detergent action on cell walls and is used to address Gram negative organisms. Bacitracin is effective against numerous Gram positive and a few Gram-negative organisms.

Pharmacokinetics: Neomycin undergoes negligible biotransformation and what is absorbed is excreted through the kidneys. Metabolics for Polymyxin B not available. Metabolics for Bacitracin not available.

I**ndications**: localized skin infections and prevention of wound infections

Dosages:

1.5 – 2.0 mm layer spread evenly across affected area and surrounding tissue

Contraindications: Should not be used for children under 2 years of age nor anyone with a known allergy to any of the components. Neomycin is notable for inducing mild allergic reaction in a significant percentage of people. Polymyxin B may increase the neuromuscular blocking activities of most medications used for same effect, including but not limited to Pancuronium, Succinylcholine and others, but it is not known whether a topical-only application will produce this effect. Neomycin lists 200 potential drug interactions. Consult a competent reference if patient is already on multiple medications. Hearing loss has been reported in people using other forms of Neomycin, but it is believed very unlikely that enough can be absorbed through topical use to present a danger.

Common Side Effects: Redness, burning with application, skin rash or other localized irritation.

Austere Production Potential: Poor, complicated production.

Part 2: Other Drugs

31. Adrenaline/Epinephrine Injection or Auto-Injector (injection)

Class: Naturally occurring stress hormone.

Pharmacodynamics: Adrenaline works by stimulating the autonomic nervous system – the one responsible for the 'fight or flight' reflex. At a detailed level, adrenaline is a direct acting adrenergic agent, acting at alpha and beta receptors within the sympathetic nervous system.

- Alpha 1 stimulation causes smooth muscle contraction, constriction of blood vessels and stimulates the release of glucose into the blood.
- Beta 1 stimulation causes an increase in cardiac contractility (the strength of heart contractions and an increase in heart rate – both increasing how much blood the heart pumps.
- Beta 2 stimulation causes smooth muscle relaxation, skeletal muscle vasodilation, bronchodilation, relaxation of uterine muscle and stabilization of mast cell membranes reducing histamine release from mast cells.

Pharmacokinetics: Adrenaline is metabolized by the liver and taken up by sympathetic nerve endings. The metabolites are excreted in urine. There are no significant effects from hepatic or renal impairment on adrenaline metabolism. The cardiovascular effects last 2-15 minutes. The mast cell membrane effect in anaphylaxis may last for several hours.

Indications:

- Anaphylaxis.
- Severe asthma.
- Severe bradycardia –slow heart rate.
- Septic shock, cardiogenic shock and neurogenic shock unresponsive to IV fluid as an infusion.
- Moderate to severe stridor by nebulizer if available.
- Topical use to help control bleeding, for example: sprayed up the nose in moderate to severe epistaxis or superficial but clinically significant external bleeding despite direct pressure.

Dosage:

Nebulized: 5 mg. Repeat as required.
IM: 0.5 mg for an adult or child weighing greater than or equal to 50 kg.
Cardiac Arrest: 1 mg IV every four minutes for an adult or a child weighing greater than or equal to 50 kg.
Dilute Infusion: 1000mls of Normal saline with 1mg of Adrenaline giving a concentration of 1:1,000,000. Titrated by eye starting at 5-10 drops per minute to clinical effect.

Contraindications: None. You should be careful in patients with a history of myocardial ischemia/ angina. Adrenaline will increase myocardial oxygen consumption.

Common Side Effects: Tachycardia, myocardial ischemia, hypertension, nausea and vomiting, tremor, anxiety and sweating and hyperglycemia.

Austere Production Potential: Production of an adrenal extract from pigs or sheep is relatively easy and

this does show some effects attributable to adrenaline when injected. The isolation of adrenaline from this product is difficult.

32. Aspirin (tablet)

Class: Aspirin is a cyclooxygenase (an enzyme) inhibitor

Pharmacodynamics: Aspirin (acetylsalicylic acid) inhibits the enzyme cyclooxygenase. Cyclooxygenase inhibition results in a reduction in the formation of prostaglandins and thromboxane resulting in antiplatelet, antipyretic, anti-inflammatory and analgesic effects.

Pharmacokinetics: Absorption occurs in the stomach and small intestine. Aspirin is predominantly metabolized in the liver with the metabolites being predominantly excreted in urine. There are no significant effects from liver impairment on short term administration.

Indications: Myocardial ischemia / angina, myocardial infarction (heart attack). Mild-moderate pain relief, especially headache.

Dosage:

Chest pain/Heart attack: 100 mg
Pain relief generally: 600mg
Pain relief headache: 1200mg

Contraindications: Known severe allergy. Avoid is possible in children. This is because of the risk of Reye's syndrome – an unusual but serious and often fatal brain condition. If possible avoid in pregnancy.

Common Side Effects: Increased bleeding. Indigestion, gastrointestinal ulceration and gastrointestinal bleeding are only associated with chronic use.

Austere Production Potential: High. Naturally occurring in the bark of willow tree species. Purification to acetylsalicylic acid is relatively complex but infusions made from willow bark extract will contain significant active drug.

33. Ibuprofen (tablet)

Class: Non-steroidal anti-inflammatory drug. Other drugs in this family include: diclofenac acid, naproxen or indomethacin.

Pharmacodynamics: Ibuprofen is a non-steroidal anti-inflammatory drug (NSAID) that inhibits the activity of the enzyme prostaglandin synthetase, reducing prostaglandin production and causing a reduction in inflammation, pain and fever.

Pharmacokinetics: Ibuprofen is absorbed in the stomach and small intestine. Presence of food in the stomach will delay absorption, but this is not usually clinically significant. Ibuprofen is metabolized by the liver and the metabolites are excreted in urine.

Indications. Mild to moderate pain (usually in combination with paracetamol), particularly soft tissue pain, musculoskeletal pain or headache.

Dosage:

400-600mg tablets three times per day as required.

Contraindications: Known severe allergy. Pregnancy. All NSAIDs can cause renal damage – caution should be used in patients > 75 particularly if seriously ill and those who are dehydrated. Care should also be taken in those with asthma as NSAIDs can cause worsening of asthma in some patients. NSAIDs can also cause or make worse stomach ulcers – if the patient develops epigastric pain while taking a NSAID – they should immediately stop.

Common Side Effects: Can cause kidney damage, Increased bleeding risk. Indigestion, gastrointestinal ulceration and gastrointestinal bleeding are usually only associated with chronic use.

Austere Production Potential: Poor. Complicated production.

34. Tramadol (tablet)

Class: Non-opiate analgesic agent

Pharmacodynamics: Tramadol is an analgesic agent that has multiple actions within the central nervous system, including opiate receptor stimulation and inhibition of the re-uptake of noradrenaline and serotonin.

Pharmacokinetics: Tramadol is metabolized by the liver and excreted by the kidneys.

Indications:

- Moderate pain, usually in combination with paracetamol and ibuprofen.
- Tramadol may be administered for severe pain if no suitable alternative is available, but do not exceed the recommended dose.

Dosage:

50mg every 8 hrs.

Contraindications: Known severe allergy. Age less than 12 years of age. Use caution if age greater than or equal to 75 years, particularly if there is a previous history of dementia or confusion. Tramadol has anti-cholinergic activity and this may cause confusion, particularly in the elderly.

Common side-effects: Nausea and/or vomiting, lightheadedness, feeling 'unusual', sleepiness, a dry mouth.

Austere Production Potential: Low. Complicated production. Synthetic.

35. Morphine (injection, tablet or oral solution)

Class: Opiate analgesic.

Pharmacodynamics: Morphine is a synthetic opiate agonist (or activator). It binds to opiate receptors in the brain and spinal cord causing analgesia.

Pharmacokinetics: Morphine is metabolized in the liver and several of the metabolites are active. The metabolites are excreted in the urine.

Indications: Moderate to severe pain. Patients with cardiogenic pulmonary edema (fluid on the lungs) or with severe anxiety and/or respiratory distress.

Dosage:

IV for analgesia:

- 1-5 mg every 3-5 minutes for an adult. Use a dose at the lower at end of the range if the patient is small, frail or physiologically unstable. For children use 0.1mg /kg

IM for analgesia:

- 5-10 mg repeated once after 10 minutes for an adult. Use a dose at the lower end of the range if the patient is small, frail or physiologically unstable. For children use 0.4mg/kg

Cardiogenic pulmonary edema / severe respiratory distress: 1-2 mg IV sparingly.

Contraindications: Known severe allergy. Too drowsy to answer questions or obey commands. Current respiratory depression (slow breathing). Use caution age less than one year (increased risk of respiratory depression).

Common Side Effects: Respiratory depression, hypotension, sedation. **n**ausea and vomiting, **h**istamine release and itch and euphoria.

Austere Production Potential: Very easy production in low-tech environment if access to opium poppies. Tincture of opium can be easily made with alcohol and production of morphine and heroin from opium is simple chemistry.

36. Ketamine (injection)

Class: Dissociative anesthetic / analgesic agent

Pharmacodynamics: Ketamine has complex actions, but is predominantly an N-methyl-d-aspartate (NMDA) receptor blocker in the brain. This results in the inhibition of excitatory neurotransmitters in the brain. Low doses cause analgesia, medium doses cause amnesia and dissociation, and high doses cause general anesthesia.

Pharmacokinetics: Ketamine is predominantly metabolized in the liver. Liver disease does not significantly alter the acute administration of ketamine.

Indications: Severe pain (in addition to other medicines), particularly musculoskeletal or burn pain that

has not been adequately controlled with an opiate. For general anaesthesia (discussed in Ch. 9)

Contraindications: Known severe allergy. Age less than one year. Current chest pain.

Dosage:

Pain relief in an adult: 20-50 mg IV every 3-5 minutes.
General anaesthesia: 1-2mg/kg IV

Common Side Effects: Transient hypertension, tachycardia. brief apnea. nausea and vomiting and hallucinations.

Additional information: Warn the patient it is possible to feel "strange" following ketamine administration. Some patients may experience hallucinations or "awful" experiences and these appear more common if sub-therapeutic doses of ketamine are administered. Midazolam in 1-2 mg doses IV may be administered if the hallucinations are severe, provided the patient is physiologically stable.

Austere Production Potential: The production is relatively low tech, but does require some complicated precursor agents which are not likely to be available in an austere situation.

37. Lignocaine/Lidocaine (injection)

Class: Amide local anesthetic

Pharmacodynamics: Lignocaine is a local anesthetic agent that blocks the initiation and transmission of nerve impulses by blocking the movement of sodium ions across the nerve cell membrane.

Pharmacokinetics: Lignocaine is metabolized in the liver with the metabolites being excreted in the urine. There are no significant effects from having liver damage on acute administration.

Indications: Local anesthetic – suitable for local infiltration and regional blocks.

Dosage:

Maximum amount is weight based	
Without added adrenaline	3 mg/kg
With adrenaline	7 mg/kg

Contraindications: Known severe allergy.

Common Side Effects: Stinging at the time of injection. Over-dosage of lignocaine when administered subcutaneously is very rare, but can occur if doses exceed 3 mg/kg or a significant amount of lignocaine (more than a few mls) is inadvertently administered intravenously. If this occurs the following may occur:

- Tingling around the mouth.
- Seizures.
- Slow heart rate.

- Hypotension.
- Cardiac arrest.

The treatment of these symptoms is to stop further administration.

Austere Production Potential: Poor. Lignocaine is technically complicated to manufacture. It is available in powder form which is suitable for long-term storage. The optimal austere local anesthetic is Cocaine – but its abuse potential and laws surrounding its possession make this a poor option too.

38. Bupivacaine (injection)

Class: amide local anesthetic agent. On the WHO List of Essential Medications.

Pharmacodynamics: blocks the generation and conduction of nerve impulses, causing a temporary loss of nerve function including, pain, temperature, touch, the sense of normal awareness of the affected area (proprioception) and skeletal muscle tone.

Pharmacokinetics: primarily metabolized in the liver, with very little (approximately 6%) excreted unchanged through the urine.

Indications: Local infiltration, peripheral and sympathetic nerve blocks, and epidural and caudal nerve blocks as indicated production of local or regional anesthesia or analgesia intended to allow wound closure, surgical and obstetrical procedures and therapeutic interventions.

Dosage:

Dosages will vary with the area requiring anesthetization, the procedure to be performed, the vascularization of the involved tissues, the desired depth of anesthesia, and the desired level of muscle relaxation.

Maximum dose experience found per medical literature was 225 mg Epinephrine 1:200,000 (5 mcg/mL) and 175 mg without Epinephrine. Doses may be repeated once every 3 hours, up to a daily total not exceeding 400 mg in 24 hours. Clinical experience beyond this point has not been is not reported. It is not recommended for intravenous regional anesthesia (Bier Block).

0.25% - for caudal, epidural, or peripheral nerve block, produces incomplete nerve block and is used where muscle relaxation is not important.

0.5% - induces motor blockade for caudal, epidural, or nerve block, results in incomplete muscle relaxation.

0.75% - produces complete motor block. Particularly useful for abdominal operations when when used as an epidural block, for complete muscle relaxation. NOT for use for obstetrical anesthesia.

Contraindications: Obstetrical para-cervical block due to history of fetal bradycardia and death. Methylparaben free preparations is not for use for spinal anaesthesia – only solutions preserved with Methylparaben should be used in those applications.

Common side effects: Allergic reactions are rare but may include nausea, vomiting, dizziness, urticarial, pruritus, etc. The most commonly encountered adverse reaction requiring immediate intervention is anesthetic-induced seizure, with a mean dosage range of 4.4 mg/Kg body weight determined through animal testing. Clinical experience has shown that such incidents occur at a rate of approximately 0.1%.

Austere Production Potential: 1950's development. Very good potential.

39. Loratadine (tablets)

Class: Non-sedating anti-histamine. Active against H1 receptors.

Pharmacodynamics: Loratadine is a long-acting antagonist (blocker) of peripheral histamine receptors. This results in blockade of the action of histamine, reducing itching, redness and hives.

Pharmacokinetics: Loratadine is predominantly metabolized by the liver with some being excreted in urine.

Indications: Minor allergic reactions effecting the skin or conjunctiva.

Dosages:

10 mg for an adult or child over 12 years of age.
5 mg (half a tablet) for a child aged 1-11 years.

Contraindications: Known severe allergy.

Common Side Effects: None.

Additional Information: Increases in plasma concentrations of loratadine have been reported after concomitant use with ketoconazole, erythromycin and roxithromycin. In a very small number of patients this was associated with a prolonged QT interval, but this only occurred with prolonged administration or very high dose (40-50mg).

Austere Production Potential: Poor. Complicated production.

40. Diphenhydramine *(Benadryl)* (tablet or injection)

(Note: Diphenhydramine is more common in North America, outside of North America the most similar agent which is commonly used, with a similar, but not identical profile (it has no local anesthetic properties) is Promethazine (Phenergan)

Class: Sedating antihistamine

Pharmacodynamics: Histamine H1 antagonist which competes with free histamine by binding at the same receptor sites. It also exhibits significant antimuscarinic activity and causes sedation in most users.

Pharmacokinetics: Primarily metabolized in the liver with the kidneys playing a very subordinate role. Excreted as metabolites, with virtually no medication remaining unchanged. Half-life is reported as 1 – 4 hours, with system clear in 24 hours.

Indications: Allergy symptoms including sneezing, runny nose, watery eyes, itching with insect bite, and to counter hypersensitivity reactions with other medications. Properties also make for usefulness as a sleep aid, anti-emetic, antitussive, hypnotic, as a mild anti-Parkinson agent, to counter vertigo associated with motion sickness, drug-induced extrapyramidal symptoms, and may also be used as a mild local anesthetic when prepared properly.

Dosages:

Adults ages 12 – over: 25 – 50 mg
Children ages 6 – 12: 12.5 – 25 mg
Off-label uses require consulting a competent reference for same. Dosages of up to 100 mg (adults) have been routinely used for some applications other than allergy symptoms.

Contraindications: Known allergy. Some persons with significant Attention Deficit Disorder may experience a contrary effect known as psychomotor hyperactivity, and should avoid Diphenhydramine as it will exacerbate their condition by way of inducing extreme restlessness.

Use with alcohol, sedatives or tranquilizers increases its sedative effects. Do not use if taking a prescription monoamine oxidase inhibitor (MAOI) or for two weeks after ceasing the MAOI. Can inhibit the metabolism of Acetaminophen. Increases the risk of adverse effects if used with Baclofen. 581 listed known or potential drug interactions - Consult a competent reference if patient is already on multiple medications. Psychosis and delirium possible when used at levels of as little as 300 mg in a signal dose (recreational use).

Common Side Effects: Sedation, fatigue, excitability in children

Austere Production Potential: Potentially very good, developed in the 1940's.

41. Promethazine *(Phenergan)* (tablet or injection)

Class: Sedating antihistamine

Pharmacodynamics: Phenothiazine-derived H1 antagonist with anticholinergic, sedative and antiemetic properties. Also has some use as a local anesthetic. Narcotic adjunct (increases the effectiveness depending on the medication and administration route). Competes with free histamine at the H1 receptor sites in the gastrointestinal tract, uterus, bronchial muscles and large blood vessels.

Pharmacokinetics: Metabolized in the liver with metabolites excreted via urine and bile. Long half-life of 16 – 19 hours.

Indications: Nausea and vomiting, alleviation of symptoms of motion sickness, light sedation, allergy relief, acute allergic reaction, allergic urticarial, adjunctive to narcotics, local anesthetic.

Dosages:

Allergy: 25 mg orally at bedtime. 12.5 mg may be taken 3 times daily as an alternative.
Motion Sickness: 25 mg oral or rectal 30 minutes before travel. May be repeated once after 8 – 12 hours if needed.

Nausea/Vomiting:

Oral route: 25 mg initially, which may be repeated as 12.5 – 25 mg every 4 – 6 hours if needed.
Rectal Administration: 25 mg initially, may be repeated as 12.5 – 25 mg every 4 – 6 hours if needed.
Intramuscular Injection: 25 mg initially, may be repeated as 12.5 - 25 mg every 4 – 6 hours as needed.

Sedation:

Children: 12.5 – 25 mg oral or rectal one time at night.
Adults: 25 – 50 mg oral or rectal taken once at night.

Special Note: for intravenous use Phenergan should be diluted in 50 ml of Normal Saline (0.9%) and infused over 15 minutes for control of nausea and vomiting. As an adjunct for narcotics (potentates) it should be diluted with 10 ml of normal saline and administered over 2 minutes.

Contraindications: Known allergy to this medication or Phenothiazine's in general, including Thorazine. Injection into arteries instead of veins during IV administration has resulted in limb amputation due to necrotic effect on artery walls. Should not be used in persons with severe respiratory impairment as it may cause respiratory depression.

Common side effects: intravenous injection can cause burning during administration; tremor, restlessness, sedation, dizziness, blurred vision.

Austere Production Potential: Potentially very good, based on 1940's pharmacological technology.

42. Ondansetron (injection or tablet)

Class: Serotonin blocking anti-emetic (anti- nausea and vomiting)

Pharmacodynamics: Ondansetron reduces nausea and vomiting by antagonizing (blocking) serotonin receptors centrally in the brain and peripherally in the gastrointestinal tract.

Pharmacokinetics: Ondansetron is predominantly metabolized by the liver with the metabolites being excreted in urine.

Indications: Significant (more than minor/ trivial) nausea and/or vomiting.

Dosages:

For patients aged 12 years and over:

- 8 mg orally.
- 4 mg IV or IM. This may be repeated once after 10 minutes.

A combination of oral and parenteral ondansetron can be given to a maximum total dose of 16 mg by all routes.

For children:

8-12 years - 6mg orally

2-7 years - 4mg orally

Contraindications: Known severe allergy. Age less than one year.

Common Side Effects: Headache**,** flushing**,** a metallic taste in mouth.

Austere Production Potential: Poor. Complicated production.

43. Paracetamol/Acetaminophen (tablet)

Class: Non-opiate analgesic (pain reliever), anti-pyretic (fever reduction)

Pharmacodynamics: Paracetamol inhibits the production of prostaglandins resulting in a reduction in pain and fever.

Pharmacokinetics: Paracetamol is metabolized in the liver with metabolites being excreted in the urine. If liver impairment is severe, paracetamol clearance will be significantly delayed.

Dosages:

1.5 g orally for an adult weighing greater than 80 kg.

1 g orally for an adult weighing 80 kg or less.

In children, the dose is 20 mg/kg

Indications: Mild to moderate pain, often in combination with ibuprofen or another NSAID.

Contraindications: Known severe allergy. Exercise caution if the patient has taken paracetamol within the last 4 hours (Paracetamol is contained in many products such as cold and flu tablets/drinks, cough mixtures, combination pain relievers and migraine tablets) or has known severe liver disease. Liver disease must be severe before paracetamol clearance is altered.

Common Side Effects: None.

Additional information: Paracetamol is not generally indicated for the treatment of fever as the fever may confer some benefit if the patient has an infection. However, paracetamol may be administered if the patient has a temperature greater than 39°C (102.2°F)degrees and the fever is causing discomfort.

Austere Production Potential: Poor. Complex manufacturing.

44. Prednisone (tablet)

Class: Corticosteroid

Pharmacodynamics: Prednisone is a synthetic corticosteroid that inhibits the production of inflammatory mediators, including prostaglandins and leukotrienes, resulting in a reduction in the inflammatory and immune response.

Pharmacokinetics: Prednisone is predominantly metabolized by the liver with the metabolites being excreted in urine.

Indications: Prednisone has wide potential uses, we have focused on the common ones.

Bronchospasm associated with asthma or chronic airways disease.

Prominent itch associated with anaphylaxis, provided all systemic signs have resolved.

Minor allergy associated with rash.

Dosages:

40 or 50 mg tablet once daily for 4-5 days
In children 1mg / kg up to 50mg.

Contraindications: Known severe allergy.

Common Side Effects: A bitter taste, fatigue, sodium and water retention (this may worsen hypertension and heart failure, but is usually only of clinical significance with prolonged dosing) or gastrointestinal reflux.

Use caution in known severe or recurrent gastric or duodenal ulcers. Prednisone increases the risk of upper gastrointestinal tract ulceration and should be withheld in this setting.

Austere Production Potential: As with adrenaline, production of an adrenal extract from pigs or sheep is relatively easy and this does show some effects attributable to corticosteroids when taken orally, but the effect is very variable.

45. Hydrocortisone (cream)

Class: topical anti-inflammatory. On the WHO List of Essential Medications.

Pharmacodynamics: In addition to anti-inflammatory actions is also known to possess antipruritic and vasoconstrictive qualities.

Pharmacokinetics: Absorption of topical applications varies widely based on a variety of factors, including skin integrity and use of occlusive dressings over the application site. Primarily metabolized in the liver and excreted by the kidneys. Some metabolites and the corticosteroids themselves are excreted into the bile.

Indications: for relief of inflammatory skin conditions.

Dosages: apply a 1.5 mm thick coating to affected area.
Dermatitis, Eczema, Psoriasis: apply 2 – 4 times daily
Hemorrhoids, Pruritus, Proctitis: apply 3 – 4 times daily

Contraindications: Known sensitivity to any of the components.

Common Side Effects: burning, itching, irritation; occur more frequently with use of occlusive dressings

Austere Production Potential: Unknown.

46. Salbutamol/Albuterol **(inhaler or nebulizer solution)**

Class: Beta-agonist bronchodilator drug

Pharmacodynamics: Salbutamol is a beta-2 receptor agonist (stimulator). Stimulating the beta-2 receptors in the lung causes bronchodilation or opening of the airways in asthma, chronic lung disease or after inhaling an irritant gas.

Pharmacokinetics: Only a small amount of the nebulized dose is absorbed, with most of the dose being nebulized to the atmosphere. The inhaled salbutamol is absorbed through the lungs and some is swallowed. Salbutamol is metabolized in the liver and excreted in urine.

Indications: Bronchospasm (spasm or closure or the airways of the lung) secondary to asthma or CORD or an irritant gas.

Dosage:

Via an inhaler + spacer:	2-4 puffs every 10 mins until relief
Via a nebulizer:	2.5mg nebulized every 10 mins until relief

Contraindications: Known severe allergy.

Common Side Effects: Tremor, tachycardia or headache.

Austere Production Potential: Low. Complicated production.

47. Loperamide (tablets)

Class: Synthetic antidiarrheal. Further classified as a Mu-type opioid receptor agonist. On the WHO List of Essential Medications.

Pharmacodynamics: Opioid receptor agonist. Works by inhibiting intestinal motility, increasing the transit time of intestinal contents and increasing viscosity of same, and reducing fluid and electrolyte loss.

Pharmacokinetics: Very poorly absorbed by the gut. Metabolized by the liver, and the unchanged drug and its metabolites are mainly excreted through the feces.

Indications: For control of and symptomatic relief of non-specific diarrhea.

Dosages:

Normally supplied in 2 mg capsules or caplets.
Adult: for chronic or acute diarrhea usual dose is 4 mg orally, followed by 2 mg after each loose stool, not to exceed 16 mg (8 units) total in 24 hours
Pediatric Dosing:
12 – 18 years: as above but do not exceed 8 mg in 24 hours
8 – 12 years: 2 mg taken 3 times the first day, then 1 tab or capsule after each loose stool but do not exceed total dose for the first day
6–8 years: 2 mg taken twice during first day, maintenance dose as needed not to exceed total dose for the first day

Contraindications: Do not use in presence of known or suspected C. difficile infection as it may result in toxin accumulation. Acetaminophen can increase concentration of Loperamide. Aspirin concentration can increase in presence of Loperamide. Approximately 398 known potential drug interactions - Consult a competent reference if patient is already on multiple medications.

Common Side Effects: bloating and constipation are noted as being rare; loss of appetite, stomach pain and nausea and vomiting are also unusual.

Austere Production Potential: Unknown

48. Magnesium Hydroxide (tablet or suspension)

Class: Naturally occurring inorganic compound with properties making it suitable for use as both an antacid and a laxative. Its properties as a magnesium salt have also resulted in its use to heal ulcerative wounds.

Pharmacodynamics:
Antacid: interacts with the hydrochloric acid in the stomach to form magnesium chloride and water. Enhances the mucosal (stomach lining) tone as well as improving the tone of both the gastric and esophageal sphincters.
Laxative: works by increasing the osmotic effect in the intestine and drawing water in, creating colonic distension, resulting in increased peristaltic movement and movement of the bowels.

Pharmacokinetics: very little is absorbed through the intestine unless the person is magnesium deficient. Does not metabolize but absorbed amounts (15-50%) are excreted through the kidneys via urine, with the remainder excreted unchanged via feces, and to a minor degree through saliva.

Indications:

Antacid: temporary relief of acid indigestion, heartburn or upset stomach. Laxative: for occasional relief of constipation.

Dosages:

` Intended action is dependent upon dose

Antacid: 05. – 1.5 grams in suspension, with expected results within 10 minutes

Laxative: 2 – 5 grams (in adults) in suspension, with expectant results in 30 minutes to 6 hours

Contraindications: Hypersensitivity to any of the ingredients. Not recommended for use in children under the age of 12 years. Can decrease absorption of tetracycline, penicillins, quinolones and ketoconazole. Can increase absorption of ibuprofen. Should not be used in persons with kidney disease or renal failure. 277 potential or known drug interactions - Consult a competent reference if patient is already on multiple medications

Common Side Effects: Excessively loose stools, bad taste in the mouth, mild stomach discomfort. Serious side effects are very rare when used within standard dosing limits.

Austere Production Potential: Excellent. Derived from naturally occurring minerals, and can be produced with 1800's-level pharm technology.

49. Omeprazole (tablet)

Class: Proton pump inhibitor, gastric acid inhibitor; anti-secretory compound. On the WHO List of Essential Medications.

Pharmacodynamics: Inhibits secretion by binding with specific enzymes, interrupting the final step in acid production. Initial onset of action starts after one hour and peaks at two hours. Up to 50% of action continues for up to 72 hours. Inhibitory effect increases with daily dosing until it reaches a plateau after 4 days. Secretion returns to baseline approximately 5 days after stopping medication.

Pharmacokinetics: Metabolized in the liver by the cytochrome enzyme system. Primary excretion is through the urinary system with approximately 25% excreted via feces.

Indications: Heartburn, gastroesophageal reflux disease (GERD), benign gastric ulcers, erosive esophagus.

Dosages:

Note – should be taken prior to eating.

Active Duodenal Ulcer: 20 mg daily for 4 weeks

Helicobacter pylori ulcer: Triple therapy – all 3 drugs are taken 3 times daily for 10 days. If ulcer is believed present at the time therapy is initiated Omeprazole should be continued as 20 mg once daily for 18 days after the other medications are completed for more complete healing and relief.

Omeprazole 20 mg
Amoxicillin 1,000 mg
Clarithromycin 500 mg

Active Benign Gastric Ulcer: 40 mg daily for 4 – 8 weeks
Symptomatic GERD: 20 mg daily for 4 weeks
Healing Maintenance: 20 mg daily. Controlled studies have not extended beyond 12 months.
Pediatrics: Age and weight based; consult competent reference.
Special Note for Swallowing Difficulty: open capsule and dispense into a tablespoon (15 ml) of applesauce, mix well and take immediately with water.

Contraindications: Known sensitivity to medication. Can increase serum concentrations of Acetaminophen, Aspirin and Ibuprofen. 485 listed potential or known drug interactions - Consult a competent reference if patient is already on multiple medications.

Common Side Effects: Most common side effects in decreasing order of occurrence include headache, abdominal pain, nausea, diarrhea, vomiting and flatulence.

Austere Production Potential: Believed to be poor due to chemical structure.

50. Ranitidine (tablet)

Class: Histamine H2 receptor antagonist, antiulcer, stomach acid reducer

Pharmacodynamics: Action is by blocking the effects of histamine on the parietal cells in the stomach, reducing acid production.

Pharmacokinetics: Parameters are similar for pediatric patients compared to adults when corrected for body weight. Metabolized in the liver and excreted through urine.

Indications: Peptic ulcer disease, duodenal ulcer, gastric ulcer, GERD, heartburn prevention associated with certain foods.

Dosages:

Benign Gastric Ulcer: 150 mg twice daily
Gastric Ulcer Healing Maintenance: 150 mg at bedtime
GERD: 150 mg twice daily
Erosive Esophagitis: 150 mg 4 times daily
Erosive Esophagitis Maintenance Healing: 150 mg twice daily
Heartburn Prevention: 150 mg taken once 30 – 60 minutes prior to ingesting foods known to cause heartburn.

Contraindications: Known sensitivity/allergy to medication

Common Side Effects: Tachycardia can result after 6 weeks of treatment in some people, limiting its long-term usefulness. H2 receptor antagonists such as Ranitidine have been shown in some studies to increase the risk for infectious diarrhea (C. dif). Rare cases of reversible mental confusion in the elderly have been reported

Austere Production Potential: Unknown; semi-complicated chemical structure.

51. Calcium Carbonate (tablet)

Class: Inorganic mineral salt used as an antacid, and sometimes as a nutritional supplement and to treat hypocalcaemia. It is a naturally occurring substance. Potential radioactive particle blocking agent.

Pharmacodynamics: Aids in restoring acid-base balance in the stomach by neutralizing hydrochloric acid and inhibiting the action of pepsin.

Pharmacokinetics: Does not undergo metabolism. May be taken up by skeletal muscle tissues and distributed into extracellular fluids. Maximum absorption takes place in doses of 500 mg or less taken with food, when used as a nutritional supplement rather than as an antacid. Excreted primarily via feces and to a slight extent by sweat glands.

Indications: Dyspepsia (GERD, heartburn, indigestion, sour stomach), hypocalcaemia
Special Note: Off-label use: potential radioactive particle blocking agent due to the affinity for the skeletal system to prefer calcium over strontium (Strontium 90)

Dosages:

Hypocalcaemia: 1,250 mgs taken 3 times daily with meals for prevention of calcium deficiency
Dyspepsia: 1,000 to 3,551 mg 4 times daily as needed, not to exceed 6,750 to 7,500 mg daily. Duration of therapy not to exceed 2 weeks.

Contraindications: 289 listed actual or potential drug interactions - Consult a competent reference if patient is already on multiple medications.

Common Side Effects: Reported as occurring at rates from 0.01 – 0.1% - constipation, nausea and vomiting, dry mouth, increased urination

Austere Production Potential: Excellent. Derived from naturally occurring minerals, minimal processing required.

52. Cimetidine (tablet)

Class: Histamine H2 receptor antagonist antacid

Pharmacodynamics: Reduces basal and nocturnal gastric acid secretion and a reduction in volume in response to food intake.

Pharmacokinetics: Metabolized by the liver with principal route of excretion via urine.

Indications: Peptic ulcer disease, GERD, heartburn. Theoretical though unproven potential benefit in addressing Acetaminophen/Paracetamol toxicity by blocking formation of metabolites of same known to contribute significantly to the toxic effects.

Dosages:

Duodenal Ulcer: 800 – 1,600 mg taken once daily at bedtime. Doses of 300 mg taken 4 times daily with meals and at bedtime have also been shown to be effective in some cases. Usual course is 6 – 8 weeks.
Duodenal Ulcer Prophylaxis: 400 mg once daily
GERD: 800 mg twice daily, or 400 mg taken 4 times daily for 8 – 12 weeks
Dyspepsia: 200 mg taken 30 – 60 minutes prior to eating
Erosive Esophagitis: 800 mg twice daily, or 400 mg taken 4 times daily for up to 12 weeks

Contraindications: May decrease serum concentration of Acetaminophen. 627 listed or potential drug interactions - Consult a competent reference if patient is already on multiple medications. Use with potential overdose levels are reported to be very high – very low risk.

Common Side Effects: constipation or diarrhea, rash, fatigue; mental confusion in the elderly possible.

Austere Production Potential: Cautiously optimistic given proper knowledge of chemistry and availability of materials and instruments. See Process for Preparing the H2 -Receptor Antagonist Cimetidine US Patent # US 4413129 A. 1970's technology.

53. Senna (tablet)

Class: Stimulant laxative. On the WHO List of Essential Medications.

Pharmacodynamics: Likely restricts water absorption by the large intestine, increasing fecal water content. Also stimulates peristalsis in the large intestine. Considered to be weaker than other non-prescription laxatives.

Pharmacokinetics: Some excretion via bile, but mostly through the feces (90%).

Indications: for treatment of occasional constipation, usually taken before bedtime, works over a period of 6 – 12 hours.

Dosages:

Adult: 8.6 mg tablets (typical) – take two tablets, not to exceed 4 tablets total in 24 hours.
Pediatric: Consult competent drug reference

Contraindications: Known intestinal obstruction, appendicitis, acute stomach pain of unknown etiology.

Common Side Effects: abdominal pain, nausea, cramps, diarrhea.

Austere Production Potential: Excellent, plant derived.

54. Docusate Sodium (liquid)

Class: Laxative of the stool softener type. On the WHO List of Essential Medications.

Pharmacodynamics: Acts as a detergent by reducing surface tension of liquids inside the bowel, allowing incorporation into the stool.

Pharmacokinetics: No metabolism. Minimal absorption in the duodenum and jejunum. Excreted with feces.

Indications: To soften stools to avoid damage caused by straining, and as an adjunct to laxatives to alleviate constipation. Available in capsule and liquid forms (liquid recommended for pediatric use). Also useful for ear wax removal.

Dosages:

Adult: 50 to 400 mg orally daily, taken in up to 4 divided doses as per total daily dose

Pediatric: 12+ - follow adult dosing
6 – 12 years: 40 – 150 mg daily, taken as divided doses per total daily dose

Ear Wax Removal: 1 capsule into affected canal 15 minutes prior to removal attempts in normal fashion (curette or ear syringe)

Contraindications: Do not use if also taking mineral oil. Stomach pain, diarrhea, cramping.

Common Side Effects: Potential for cramping, bitter taste. Hypomagnesemia has been reported (very rare).

Austere Production Potential: Very good, assuming technology and knowledge available.

55. Sodium Phosphate (enema)

Class: Saline laxative

Pharmacodynamics: Increases fecal mobility in the large intestine by increasing the water content by way of osmotic action.

Pharmacokinetics: Not metabolized, excreted with feces.

Indications: Constipation, bowel prep before procedures.

Dosage:

19 Gram Sodium -7 Gram Phosphate - 118 Ml water (Fleet's formula unit dose)

One unit dose applied rectally. May repeat after 24 hours.

Contraindications: Do not use for under 2 years of age. Possible drug interaction (unspecified) with NAIDs and diuretics.

Common Side Effects: Mild abdominal discomfort, flatulence, cramps.

Austere Production Potential: Very good, involves basic low-tech chemistry only.

56. Psyllium (tablet/powder)

Class: Bulk laxative

Pharmacodynamics: Psyllium soaks up water from the bowel to create bulk. It is composed of a natural fiber derived from the Plantago sp,

Pharmacokinetics: Excreted unchanged in the stool.

Indications: Treatment of occasional constipation. Normally works in 12 – 72 hours.

Dosages:

Based on total dietary fiber intake, of which psyllium may be only one component.
Consume at least 8 ounces of liquid with each dose.
Adults: Male – 38 grams/day Female – 25 grams/day
Over 50 years of age: Male – 30 grams/day female – 21 grams/day

Contraindications: fecal impaction, bowel obstruction; long-term use can result of dependency on the product for production of bowel movements.

Common Side Effects: Constipation, abdominal pain, cramping, flatulence.

Austere Production Potential: Excellent cottage industry production potential – plant based.

Appendix 3: Antibiotic/Disease Matching.

In modern medicine, there are usually multiple suitable antibiotics for any specific condition. However, in an austere environment the options are substantially reduced. What we have done here is to try and match a couple of common simple antibiotics to each common infectious condition. We have also tried to offer an alternative – which, while possibly not as good as the first choices, is an acceptable agent. Please note our first choices are not necessarily the best antibiotic available on the market for that problem – but they are simple and widely available ones, which are suitable options.

This section does not describe the diagnostic process – it assumes you already have made the diagnosis.

Also note that what antibiotic is first choice varies by country and even areas within a country. We have tried to offer widely available agents which are suitable for most locations.

Please remember: if you think the problem is likely to be viral – antibiotics have no impact on viral infections and should not be used.

We have specified adult doses. For the child dose, please consult a suitable reference. A safe, but not perfect, rule of thumb based on weight is:

50 kg/110 lbs	adult dose
40 kg/88 lbs	80% adult dose
30 kg/66 lbs	60% adult dose
20 kg/44 lbs	40% adult dose
10kg/22 lbs	20% adult dose
5kgs/11 lbs	10% adult dose

Definitions.

OD	Once daily
BD	Twice daily
TDS	Three times daily
QID	Four times daily
PO	By mouth
IV	Intravenous

Unless otherwise stated, the length of the treatment course is for 5 days or for 48 hrs following resolution of primary signs and symptoms.

Problem	First choices	Acceptable Alternatives
Severe Sepsis (cause unknown)	Ceftriaxone 1gm BD IV Metronidazole 500mg TDS PO/IV **OR** Ciprofloxacin 500mg BD PO/IV + Metronidazole 500mg TDS PO/IV	Amoxicillin/ Clavulanic 1.2gm IV TDS **OR** Amoxicillin/ Clavulanic 625mg PO TDS
Cellulitis		
Skin	Flucloxacillin 500mg TDS IV/PO **OR** CoTrimoxazole 480mg BD PO **OR** Cephalexin 500mg PO TDS	Clindamycin 300mg TDS PO
Infected Wound	as per skin	
Bite (human)	Amoxicillin/Clavulanic 625mg PO TDS	Cephalexin 500mg TDS PO
Bite (other mammal)	as per bite (human)	
Bite (insect)	as per skin	
Impetigo (not unwell)	Daily betadine or chlorhexidine washes BD **OR** Mupirocin topically BD for 5 days	Flucloxacillin 500mg PO TDS
Impetigo (unwell)	as per skin	
Abscesses	generally not required, unless unwell or significant associated cellulitis.	
Mastitis	as per skin	

Chest

Mild	Amoxicillin/Ampicillin 500mg PO TDS	Penicillin 500mg PO TDS **OR**
Severe	Ceftriaxone 1gm IV OD + Erythromycin 500mg IV/PO TDS **OR** Amoxicillin/Ampicillin 500mg PO/IV TDS + Erythromycin 500mg TDS PO/IV	Cephalexin 500mg PO TDS

Abdominal

Peritonitis	Ceftriaxone 1gm IV BD Metronidazole 500mg PO/IV TDS **OR** Ciprofloxacin 500mg PO/IV BD+ Metronidazole 500mg PO/IV TDS **OR** Amoxicillin/Clavulanic 1.2gms IV TDS	Amoxicillin/ Clavulanic 625mg **PO TDS**
Appendix	as peritonitis	
Other	as peritonitis	

Nervous System

Ceftriaxone 1gm BD IV	Amoxicillin / Clavulanic acid 1.2mg IV or 625mg
OR	PO
Penicillin 1.2gms QID IV	

Tetanus

Metronidazole 500mg PO/IV TDS	Penicillin G 1.2 gms IV QID
OR	
Penicillin VK 500mg PO QID	

N.B. kills bacteria and stops further toxin production, but does not stop existing toxin causing disease.

Throat Infection
(presumed bacterial)

Penicillin VK 500mg QID for 10 days
OR
Cephalexin 500mg TDS for 10 days

OR
Amoxicillin 500mg TDS for 10 days

Ear/Sinus Infections

External ear

Mild/Moderate	Sofradex (or equivalent) ear drops QID
Severe	Flucloxacillin 500mg PO/IV TDS OR Amoxicillin/Clavulanic 625mg PO TDS
Middle ear	Cephalexin 500mg PO TDS OR Amoxicillin 500mg PO TDS
Presumed bacterial Sinusitis	as for middle ear

Dental Infections

Penicillin 500mg QID PO
OR
Amoxicillin 500mg TDS PO
+/-
Metronidazole 500mg PO TDS

Clindamycin 450mg PO TDS

Joint/Bone

Septic joint	Aspiration plus Ciprofloxacin 500mg BD PO for 14 days **OR** Flucloxacillin 500mg TDS PO for 14 days
Osteomyelitis	Ciprofloxacin 500mg BD PO for 42 days + Cotrimoxazole 480mg TDS PO for 42 days

Sexually Transmitted

Likely gonorrhea or chlamydia	Azithromycin 1.5gms as a single dose + Doxycycline 100mg OD for 10 days **OR**	Ciprofloxacin 500 PO BD for 10 days

	Ceftriaxone 250mg IM single dose + Azithromycin 1.5gm as a single dose	
Syphilis	Doxycycline100mg BD PO for 14 days **OR** Penicillin VK 500mg QID PO for 14 days **OR** Penicillin G 2.4gms IM as a single dose	
Trichomonas	Metronidazole 2gms PO as a single dose **OR** Tinidazole 2gms PO as a single dose	
Pelvic Inflammatory Disease	Ceftriaxone 250mg IM as a single dose + Doxycycline 100mg BD for 10 days	
Testicular/Epididymitis	Ciprofloxacin 500mg BD PO **OR** Cotrimoxazole 480mg TDS PO	Doxycycline 100mg BD PO
Prostatitis	Ciprofloxacin 500mg BD PO For 10 days	Amoxycillin/ Clavulanic 625 TDS PO for 10 days
Urinary Tract	Trimethorim 300mg OD for 3 days* **OR** Amoxicillin 500mg TDS for 3 days* OR Cotrimoxazole 480mg TDS for 3 days* ** In children and men for 10 days*	Ciprofloxacin500mg BD for 3 days
Pyelonephritis	Amoxicillin/Clavulanic 1.2gms IV TDS **OR** Amoxicillin/Clavulanic 625mg PO TDS **OR** Ciprofloxacin 500mg BD PO	Cotrimoxazole 480mg BD PO
Gastroenteritis		
high fever/bloody diarrhea	Ciprofloxacin 500mg BD PO	

presumed cholera	Doxycycline 300mg single dose **OR** Ciprofloxacin 500mg single dose
presumed giardia	Tinidazole 500mg OD single dose **OR** Metronidazole 500mg TDS PO

Rickettsial Disease

Rocky Mountain Spotted Fever	Doxycycline 100mg BD PO
Typhus	as RMSF

Tularemia

as RMSF, except for 14 days

Ciprofloxacin500mg BD PO for 14 days

Lyme Disease

Doxycycline 100mg BD PO 10 days

Amoxicillin 500mg PO TDS for 14 days

Bio-weapons

Anthrax

Prophylaxis	Ciprofloxacin 500mg BD PO for 60 days **OR** Doxycycline 100mg BD PO for 60 days	
Skin	Ciprofloxacin 500mg BD PO for 10 days	Doxycycline 100mg BD PO for 10 days
Pulmonary	Ciprofloxacin 500mg BD PO for 60 days+ Clindamycin 900mg TDS for 60 days	

Plague

Doxycycline 100mg BD for 10 days
OR
Ciprofloxacin 500mg BD for 10 days

Appendix 4 Medical Equipment Use and Fault Finding

The advance of technology and proliferation of advanced medical devices has revolutionized the health care industry. It has allowed for quick and accurate diagnoses of conditions as well as delivering effective treatment to patients. The complexity of these devices requires regular maintenance to ensure safe and effective operation of the device, something which is often a challenge in austere conditions. This chapter is a basic run through of fault finding and maintenance of medical devices to help preserve their availability to care givers.

Medical devices can be broken down into two basic types:

Diagnostic devices: These devices are used to help the caregiver diagnose medical conditions and issues. They may or may not deliver energy or force to the patient. Some examples of diagnostic devices are: X-ray machines, Electrocardiogram (ECG) machines, Blood pressure monitors, Glucometers, pulse oximeters, etc.

Therapeutic devices: These devices deliver an energy, force or substance to the patient to achieve a clinical effect. Some examples of Therapeutic devices are: Defibrillators, Infusion pumps, syringe drivers, electrosurgical units (diathermy), traction machines, etc.

A. What Normally Fails?

In my experience as a Biomedical Technician, the causes for reported faults can roughly be broken down into the following:

Operator induced faults (60%): these are issues caused by the operator not fully understanding how the device operates, what it is doing or what settings have been chosen. Given the increasing complexity of modern devices and the tight staffing levels in most facilities, it is understandable that staff may not have the time to become fully conversant in the use of a particular device.

Failure of accessories and non-durable parts (20%): this is failure of leads, sensors, hoses, cuffs, batteries, etc. The failure of such items is considered normal wear and tear but is still a significant problem and with basic precautions and be greatly minimized.

Mechanical damage (15%): this is where the device has been dropped or damaged in some way. In an austere environment, this normally removed the unit from service.

Internal component failure (5%): this is where and internal part like a circuit board has failed. From my experience, this occurs far less than most clinicians would realise.

B. How to Minimise the Issues

The following is a list of easy to do steps that will help to prevent the most common causes for failure of medical devices:

Read the user manual and become knowledgeable in the use of the device: in particular, what the device is used for, how it operates, what settings can be chosen, and the basic fault finding detailed in the user manual.

Treat the device like it is fragile: while most devices are quite robust, in an austere environment spare parts may not be available so if the unit is dropped or damaged, it most likely will not be repairable.

Treat the accessories like they are fragile: The leads, cuff, hoses, etc. on a device are one of the most easily damaged items. Keep leads tidy and out of the way when not in use to minimise damage.

Have spare accessories, consumables and non-durable parts: at some stage these will break and having spares will help ensure the continued availability of the device.

Keep the unit charged: If the device has rechargeable batteries, keep it plugged into power where possible and do not run down the batteries often. A device that is run down on batteries often may only have a battery lifespan of 6 – 18 months, where a device that is kept on charge and not flattened often can last many years. I have seen the batteries in some units last 15 years!!!

Have back up manual procedures and devices: By having a low tech manual way of doing what the device does, it minimises the risk if a device fails. For example an IV bag and giving set as a back up to an infusion pump, a manual sphygmometer as a back up to an automated vital signs monitor, etc.

Have technical capability within the group: where possible have a member of the group get some basic technical training and basic hand tools/test equipment, get the user and service manuals for any devices you have (most are available online), get spare parts for any external components on the device that could be damaged (including fuses). Due to the expensive nature of biomedical test equipment, it is unlikely that most groups would have these on hand but some test equipment can be improvised or made for a low cost such as ECG simulators or pressure gauges. There are many plans on the internet for such items.

C. Fault Finding a Device.

Generally, issues to a device can normally be divided into two parts: power-related issues (i.e. not turning on) and function-related issues (i.e. not operating correctly). If a device is reported as faulty, first check the basics: is the unit plugged into power? Is there power at the power point? Does the power light on the device come on? Does it switch on? Does it run on battery. The answers to these questions will normally point to the cause of the issue.

Some examples:

1) Device is plugged into power, power point is operating correctly, the power light on device does not come on. Possible causes – power cord faulty or not plugged into back of device fully, power switch on rear of device not on, fuses in device are blown, internal fault.

2) Device is plugged into power, power point is operating correctly, the power light on device comes on but unit does not switch on. Possible causes – faulty battery, screen settings incorrect, internal fault.

3) The device is powered by disposable batteries but does not switch on. Are the batteries good? Are they inserted correctly?

If the unit turns on but is not operating correctly, ask the following: Are the settings correct for what I am trying to achieve? Have I configured or set up the device and accessories correctly? Which functions are working and which are not? Does the fault occur all of the time or is it intermittent?

Some examples:

1) Vital signs monitor turns on, it takes blood pressure and temperature but the pulse oximeter only works some of the time. Possible causes – incorrect positioning of pulse oximeter probe, intermittent fault with the pulse oximeter probe or cable. In this situation you could use the spare pulse oximeter probe and cable (if you have them) to verify the fault and rectify it.

2) ECG machine has noise on the print outs or traces: does this occur only when plugged into the power point or on battery as well? Check leads and electrodes are placed correctly, check electrodes are fresh and not dried out, check settings for "mains filter", wiggle the ECG cable to see if that induces the noise (i.e. intermittent fault with lead).

3) The manual blood pressure gauge needle drops: Can you pump it up fully? How quickly does it drop? Check hoses, connectors and bulb for fitting and leaks.

4) The oxygen regulator leaks: Where is it leaking from? Are the o-rings and seals undamaged?

To recap the process of fault finding, if faced with a “faulty device” ask these questions:

- Have I set up the device and accessories correctly?
- Have I selected the correct settings for what i want to achieve?
- Do I know how the device works?
- Is the unit turning on or not?
- Is the unit operating correctly or not?
- What is working and what is not?

While it might seem overwhelming to fault find a medical device, if you break the process down into steps and focus on each step, the root cause of the fault often becomes apparent with little effort in fault finding it. Having a range of basic medical devices can be a force multiplier for the caregiver in an

austere environment and while requiring some extra planning and resources, these can be effectively used and maintained.

D. Electrical Safety in Healthcare Facilities

There are certain devices and procedures which reduce the resistance of the patient's skin, for example ECG electrodes or catheters with conducting fluid going into the blood stream. This then means it takes only a small amount of electrical current to possibly cause the patient's heart to stop, basically like being electrocuted by touching a live wire but only requiring a fraction of the voltage and current normally associated with electrocution.

To help ensure patient safety, most facilities have certain devices and protections built in to the power supply system that minimize stray voltages and currents which might harm the patient. An austere environment would normally not have such protections so it is important that the users are aware of possible issues and minimise the risks. Some basic precautions than can be taken are:

- Use a portable Residual current Device (RCD – "Safety switch") of 10mA between the power point and the device (if you have one).
- Use devices that have built in protections (most modern medical equipment should). This is normally indicated by a small person or a heart figure on the device.
- If there is no built in/added protection on the power supply like a 10mA Residual current Device (RCD – "Safety switch") or Isolation transformer then, if the device or procedure reduces the patient's skin resistance via electrodes or conductive fluids, use the device on battery where possible.
- Keep other electronics/electrical devices (especially non-medical) more than an arms distance away (1.5 meters) to ensure the caregiver does not provide an electrical path by touching other devices and the patient at the same time.

The key point to remember is that the issue is mainly when doing procedures which reduce the skin resistance of the patient. Something like using an infusion device with non-conductive tubing & IV bag normally represents a low risk. Think about this issue when setting up treatment areas.

E. Powering Devices in an Austere Environment

Providing reliable power to devices can be one of the biggest challenges in an austere environment. If you have the ability to pre-plan and equip, then suitable arrangements can be made to ensure a sustainable power supply. If you only have a few devices of low current draw, for example infusion devices, ECG machines, vital signs monitors, defibrillators etc. and not high current draw devices such as patient warmers, electrosurgical units and X-ray machines, then a relatively small solar system can provide you with an almost indefinite supply. Such a solar system would be comprised of: solar panel,

charge controller, 12 volt battery (i.e. car battery) and power inverter (to change the 12volts into 110, 240 or whatever voltage the country/device uses).
Example of a solar set up (120w solar panel with charge controller, 100ah battery and 600w inverter – total cost $400 AUD at time of writing):

To work out your needs, first look at the compliance plates on the devices you have. This will tell you the required voltages and currents (or power) required to run them. By adding up the required current or power, you can work out what size of inverter you need (add 50% to be sure). Make sure you get an inverter that is both "pure sine wave" and "electronically isolated". Extra care must be taken when using an inverter as there is a much higher risk of stray voltages and electrical safety issues as described in the paragraphs above. If using these setups, it is preferable to use them to recharge device batteries away from the patient instead of powering the device while connected to the patient to minimise risks. Some medical devices actually have a 12 volt inputs which simplifies connecting them to such a system.

If you have devices that run on disposable batteries such as AA or AAA types, then adding a suitable battery charger and a few sets of high quality rechargeable batteries such as “Eneloop AA” will give you the ability to run the devices almost indefinitely from the sun!!!

For information about how to set up a solar system (a book in itself), there are many sources on the internet which give basic instructions that almost anyone can follow. Google "solar generator" for some examples of what is possible.

Battery Failure and Improvising Power Supplies

At some stage batteries will fail. This may be a few months or many years depending on how the device has been treated. Older devices have common batteries such as 6 volt or 12 volt lead acid types. If you are unable to source a suitable replacement then the battery terminals in the device can sometimes be attached to other batteries of the same voltage. For example, if the internal battery is a 12 volt type, you may be able to runs some wires and power it directly from a 12 volt car battery. Care must be taken to

ensure that the correct voltages are used and that the correct polarity for the connections are made or the device may be permanently damaged.

It is impractical for the layperson to improvise batteries for most modern devices using internal lithium batteries due to battery management systems and microprocessors built into the batteries. A lot of these devices won't work unless a genuine and non-expired battery is inserted.
In some cases a power pack may be used instead of the internal battery, but care must be taken to ensure that the correct voltage is selected, the correct polarity of the wires are used, the correct current rating of the power pack is selected for the device (both for stand by currents and when active – such as a defibrillator charging) and its best to use a regulated power pack to reduce overvoltage and damage. Something else to consider is that doing this will most likely reduce any built in electrical protection the device has and could possibly present a high electrocution risk to the patient if skin resistance-lowering procedures are being used. **Great care must be taken when modifying devices away from their designed parameters.**

F. How to Test Common Items

1. Power Packs

First off is some basic electrical theory. Some main terms you will need understand are: voltage (Volt - V) which is the commonly used term for electrical potential difference. Electric current (ampere - A) is the flow of an electric charge. Current can be broken into two different types: alternating current (AC), where thee charge periodically reverses direction (back and forth) and direct current (DC) where the flow of electric charge is only in one direction. Electrical resistance (Ohm - symbol Ω) - is opposition to the flow of steady electrical current.

To work out what is happening with an electrical circuit we use a formula called Ohm's law which states that the current through a conductor between two points is directly proportional to the voltage across the two points, and inversely proportional to the resistance between them.
Ohm's law is **Voltage = current x resistance (V=IR)**

By changing the formula you can work out current or resistance for a circuit:

- **Current = Voltage divided by resistance I= V/R**
- **Resistance = Voltage divided by current R= V/I**

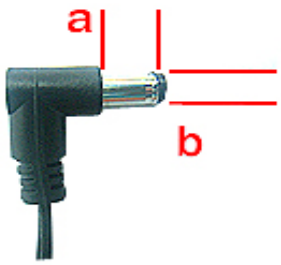
Other terms that are handy to know**:** Watts (W) – electrical power, Volt amps (VA) – electrical power, Hertz (Hz) – Frequency, Alternating current (AC) – Type of electrical current, Direct Current (DC) – Type of electrical current, Load – circuit connect to a power supply, Open circuit - No load on power supply output, Short circuit – power supply output shorted together, Earth (ground) -reference point from which other voltages are measured, Insulation -material that resists the flow of electrical current, Mains Adapter – another name for plug pack.

There are multiple types of power/plug packs available, the main types we are concerned with are:

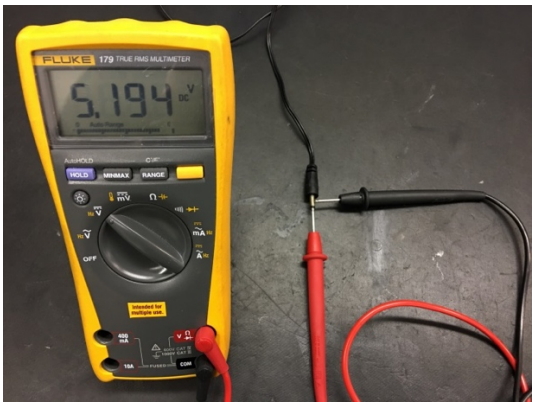
1) **AC output** which has an alternating current (AC) output and is mainly used in specialist applications.
2) **DC Unregulated** output which has direct current (DC) output and produces a particular voltage at a particular output load current (i.e. 12v at 500mA). The voltage may rise or fall depending on load and the open circuit voltage is higher – i.e. a 12v plug pack may have a 17v output without a load. This is often used as it has less cost.
3) **DC Regulated** output which has direct current (DC) output and maintains output voltage regardless of load (within reason), is often used for sensitive applications, has little or no ripple voltage and is more expensive.

When testing a power pack the things to look for are:

- Output voltage
- Current rating
- AC or DC output
- Regulated or unregulated output
- Polarity of output connector (which pin is positive and which is negative) as well as the physical size of the connector such as length of connector (A) , outside diameter (B) and inside diameter.



The main tests performed on plug packs are: visual inspection of power pack to ensure there is no damage to the unit, voltage output testing, electrical safety testing (where possible). To test the voltage output of the plug pack a multimeter is used. Once the appropriate settings have been selected, the voltage is measured on the output pins. This can be used to test the polarity of DC plug packs



Common problems with power packs:

- Damaged cases
- Damaged or lost plugs
- Bent or damaged mains pins
- Intermittent connection in cable or connectors
- No output (common)
- Incorrect output/internal fault (rare)
- **Wrong plug pack being used!!!!**

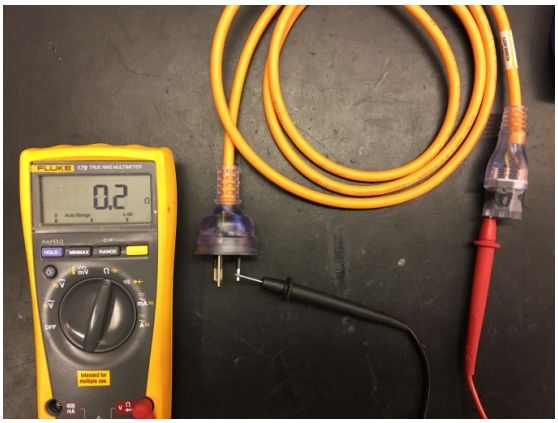
2. Power Cords

Detachable power cords can sometimes cause issues. Without expensive test equipment, it can be hard to test the cords fully but some basic tests using a multimeter can tell if the power cord is fine for use. As each countries power connections are different, make sure you check which are the earth connections and other connections to ensure you can test the lead correctly. Also it is a wise choice to check the legislation of any country you are in to ensure that you do not breach any laws and are complying with any standards, which may regulate which tests are required, who can do them and what are suitable values to pass these tests.

Tests for power cords

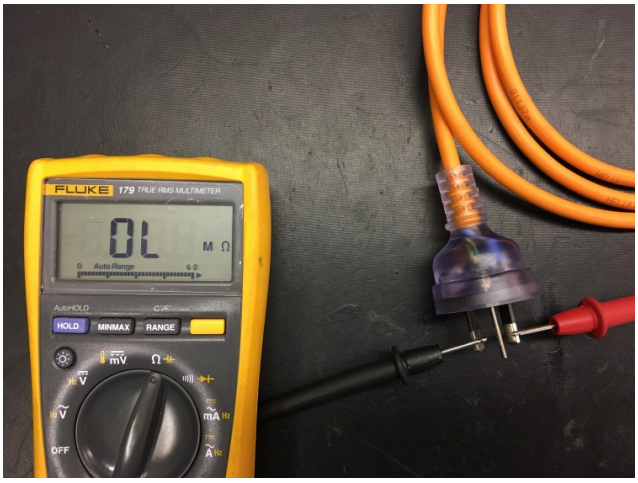
WARNING – Do not test power cords while they are still plugged into the mains supply unless suitably qualified and trained. Only test cords that are unplugged. Mains voltages can kill!!!
Visual inspection - look for kinks in the cord, cuts or damage to the cord or bent input pins.

Continuity of main conductors - with the power cord disconnected from mains electricity, set the multimeter for resistance and place one of the test leads to each of the input pin and the other to the corresponding output socket for the conductor you are testing. You should read 1 ohms or less (this may vary with country and legislation). Do this for both conductors.



Earth continuity test: (if the cord has an earth conductor) – with the power cord disconnected from main electricity, set the multimeter for resistance and place one of the test leads to the earth input pin and the other to earth output socket. You should read 1 ohms or less (this may vary with country and legislation).

Insulation test – While a proper insulation tested should be used to correctly test this, a multimeter can give a basic indication of the insulation resistance of a cable. Place one test lead to one of the input pins and the other test lead to the other input pin. You should measure very high (almost infinite) resistance.



3. Blood Pressure Cuffs & Accessories

NIBP accessories generally consist of one or more of the following components:

- NIBP cuff
- Hose
- Connectors
- Pressure gauge
- Inflation bulb

NIBP cuffs may be constructed as one piece or they may be with a separate inner bladder and outer cover. They may have one or two hose connections depending on the intended use and brand

NIBP hoses are often made from plastic or rubber with connectors on each end. There are multiple types of connectors available depending on the manufacturer. These connectors may be removable or may form a part of the hose itself. Ensure that the connectors on the NIBP accessory are appropriate for that brand.

The pressure measuring device in a NIBP system may be part of an electronic machine or it may be a stand-alone mechanical pressure gauge (or mercury column) depending on measurement method.

Some systems include a manual inflation bulb. It consists of a one-way valve in its base as well as a cut off/deflation valve on the other end.

Physical Check

- Look for damaged connectors on both ends of the hose or cuff. Check any O rings as damage to this is a common problem.
- Check the joint where the two tubes separate (if fitted) for damage.
- Check for any damage or deterioration to the cuff (including Velcro, etc.).
- Check the correct connectors are fitted for the brand type.

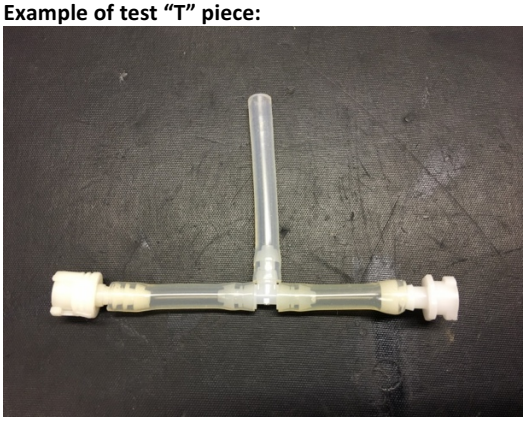
Leak testing

- It is a good idea to test as much of the system together as possible.
- Test using a bottle, pipe or similar item to wrap cuff around. Inflate the cuff and note how quickly the pressure drops. It should be less than 5mmHg per minute. A mixture of soapy water can be used to find the exact location of any leaks.
- Check for intermittent faults by "wiggling"hoses around the connectors and looking for a pressure drop.

Checking pressure gauge accuracy

If the accuracy is in question, use another gauge to compare it against by inserting the second gauge in the system via a "T- piece" and conducting the leak test as above (it should be within a few mmHg of each other).

Example of test "T" piece:



Common problems and issues

- Damaged connectors (check O rings!!)
- Damaged tubes.
- Damaged or leaking cuffs.
- Intermittent leaks in hoses, cuffs or connectors – especially around joints.
- Have a few spare parts for any system you have (i.e. connectors and bulbs, etc.) as well as some T pieces and hoses bits for testing.

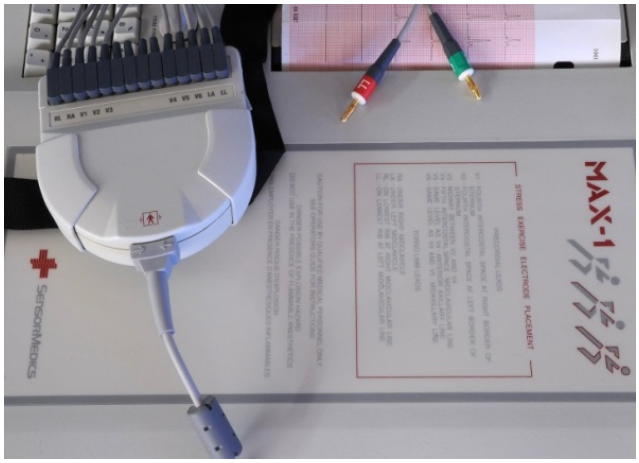
4. ECG Cables

ECG leads come in a variety of types, lengths and style depending on their use and parent machine type. The two main ECG machine types are: 12 lead ECG machines and patient monitors. The number of leads an ECG machine uses varies with its purpose. Some common types are: 3 lead, 5 lead, and 12 lead.

ECG leads may be constructed as one piece or they may be in multiple parts. The most common multi part leads consist of the following sections:

- Trunk cable
- Patient leads (known as "tails")
- ECG leads can also have multiple types of clips to attach to the electrodes such as grabber, alligator or press on clips. These clips may be removable or may form a part of the cable itself.

There are also different types of connectors that attach the lead to the machine. These vary with the manufacture. Some machines have a device in its leads called an acquisition module or a patient interface module. This device has complex electronics in it and quite often costs several thousand dollars (**don't throw it out!!)**.



Testing ECG Leads

Physical Check

- Look for damaged or corroded connectors on both ends of the cable (including clips & screws)
- Look for damaged or deteriorated cable
- Clear and correct markings / labels
- Cracks and cuts can cause infection control issues even if the cable still works.

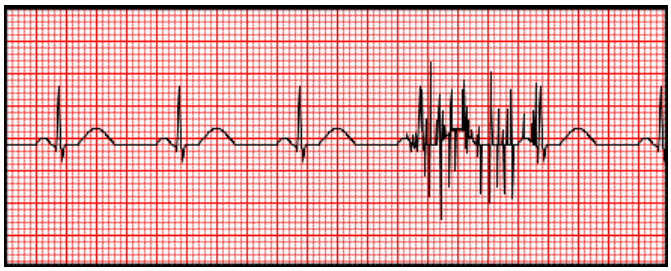
Testing Cable Function

The best way to test these cables is testing using a multi-parameter (ECG) simulator. These units can cost thousands of dollars so it is unlikely one will be available in an austere environment (although homemade units can be made cheaply via plans from the internet).

The leads can be tested while connected to the patient, but care must be taken to ensure that the points where the leads connect to the patient are kept very still, as any movement here can induce artefact on the printout which can be mistaken as a fault.

While keeping the patient-side connections very still, check for intermittent faults by "wiggling" the cable around the other connectors and along its length while ensuring the ECG signal is displayed in the ECG machine without noise or dropouts.

Example of a noisy/intermittent ECG signal:

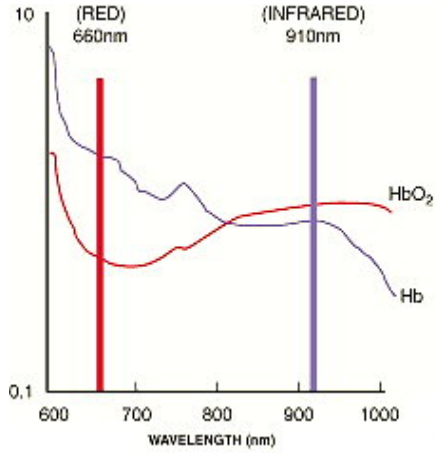


Common problems & issues

- **Number one cause of ECG artefact is poor skin preparation and/or dried out electrodes**
- Damaged or dirty clips
- Damaged or corroded connectors
- Damaged cables (cut or crushed)
- Intermittent connection in cable or connectors

5. SpO2

To measure Sp02, a sensor is placed on the patient's fingertip or earlobe. A light containing both red and infrared wavelengths is used and the amount it is absorbed by the body is used to measure the oxygen saturation. The red and infrared wavelengths of light are absorbed by oxygenated haemoglobin and de-oxygenated haemoglobin at differing levels for each wavelength.



The most common method for measuring the SpO2 levels is where the light is transmitted from one side of the patient's finger or ear and received by a sensor on the other. Some technologies use reflectance where the transmitter and receiver are side by side and the light is reflected back from the patient's tissue. They may be designed for adults, paediatric or neonate patients and may be reusable or disposable.

Some common SpO2 accessories are:

- Finger probe
- Ear probe
- Multi-site probe
- Reflectance probe
- Extension cables

Testing SpO2 Accessories

Physical Check

- Check for damaged connectors on both ends of the probe or cable including missing or bent pins, missing covers, etc.
- Check for damage on the probe head such as bent springs, torn rubber, cracked housings, etc.
- Check for cut or damaged cables.

Function Testing

Function testing ensures that the probe is operating correctly. It can be done in several ways using:

- SpO2 probe tester or SpO2 simulator - to allow verification of units accuracy
- Placing unit on finger – checks function but not accuracy. If you have several units you can test the measured values against each other but this is of limited value.
- A mobile phone or camera that is sensitive to the infrared light (910nm) may or may not help diagnose if the unit is operating correctly.

Unfortunately, Spo2 testers cost thousands of dollars and there is no cheap way of testing the accuracy of the units. For the small fingertip stand-alone units, there is very little that can be done if faulty.

Common problems & issue:

- Dirty probes causing a reduction or loss of light transition.
- Incorrect placement or patient related issues (i.e. nail polish, dirty fingers, etc.)
- Damaged connectors and bent pins.
- Damaged probes – split or cut rubber/loose springs.
- Damaged or cut cables with intermittent connection.

G. List of Recommended Test Equipment and Supplies

The following is a list of basic test equipment and supplies that can help maintain medical equipment to ensure its availability and possibly repair it if a failure occurs.

- Multimeter – buy the best quality auto ranging multimeter you can including a couple of spare fuses and batteries for it, maybe a spare set of leads too.
- Soldering Iron -60 watt or more.
- Solder - Resin-cored 60/40 solder (1mm diameter and around 200g).
- De-soldering wick.
- Screwdriver set – with Philips and flat blade.
- Jewellers screwdriver set.
- Any specialist drivers (i.e. torx) that the devices you have might use.
- Allen key set (metric & imperial).
- Pliers – large and small.
- Wire snips – small.
- Adjustable wrenches – small & large.
- Fuses – for any devices you have plus multiple types and values just in case.
- Sets of misc. screws, nuts and bolts.
- Misc. sizes of hose clamps.
- Electrical tape.
- Methylated spirts (for cleaning electronics, etc.).
- Misc. lengths and sizes of various wires and cables.
- Multitool – always handy.
- Manuals (service and user) – for any device you have.
- Spare power packs and power cords

- Spare probes and leads – If you can.
- Information books – such as "How to Test Almost Everything Electronic" by Delton T Horn

H. What medical devices do I need?

As we have mentioned earlier in this appendix, appropriate medical devices in an austere medical situation act as significant medical force multipliers to use the military term. While none are vital for the provision of medical care, they can significantly enhance that care. However, it is expensive to obtain and the maintain medical equipment. We have prioritized what in our view (in order) is the medical equipment you should seek to obtain. Please note, that before even considered the 'machines and gadgets' you should ensure you have addressed all the basics first. It is a common mistake to spend money on devices, when you cannot even provide simple A B C level care.

1. Manual blood pressure cuff
2. Automatic blood pressure cuff*
3. Tympanic thermometer*
4. Finger-tip pulse oximeter*
5. Automatic advisory defibrillator – preferably with 3 or 6 lead monitoring and a spare battery*
6. Glucometer
7. Battery powered otoscope/ophthalmoscope
8. Autoclave – requires main power generally. Several off-grid devices available but they are rare and expensive.
9. Cautery pen
10. Small portable oxygen generator.

**these 4 devices can be replaced with a single defibrillation and monitoring unit; however, the cost is likely to exceed the cost of small individual component items.*

Note. all the devices (except 1 and 8) require batteries – for most a supply of rechargeable AA or AAA batteries is all that is required. However, for defibrillators and portable oxygen generators they generally require very specific/complicated rechargeable or single use batteries. You need to ensure you have replacement batteries or a method to safely recharge them.

Appendix 5 Medication use in animals

As this book is a guide for human health care and assumes that replenishing supplies is not likely, using your precious, limited supply of antibiotics and other medications on animals is not considered sensible. However, we realize that there may be times when your best guard dog gets wounded or the community cow suffers from a retained placenta and you really need these animals to be healthy so your operation can function. It is in this light that we offer the following information to guide your use of medications in animals. It is a basic list but should be complete enough for the most common problems you may encounter.

In general, each antibiotic is useful for the same infections in animals as they are in people. For instance, clindamycin is an excellent choice for dental and skin infections in both dog and man. The doses for animals are often higher than what is used in humans.

The route of administration in animals can be different than humans. Simple stomached animals such as dogs, cats, horses and pigs can take most medications by mouth just like people. Ruminants, on the other hand, have a series of 3-4 portions of their stomach (rumen). These special compartments are full of bacteria that ferment the grass they eat in order to turn it into useful nutrients for the animal. Because of this fermentation, many medications you would give them by mouth are inactivated in the rumen. For this reason, cattle, sheep, goats, alpacas & llamas generally need to receive medication as an injection.

We tend to treat animals for 7-10 days for most bacterial infections. The rule of thumb is to treat for at least 2 days after the animal is back to normal.

Because the size of animals is variable, we dose them by weight. Figuring the dose is fairly straightforward, though. First, obtain the weight of the animal (or as close thereto as possible). The weight should be in kilograms. If it is in pounds, simply divide the number of pounds by 2.2 to know how many kg it weighs. Then multiply the weight in kg x the recommended dose (i.e. 5mg/kg) to know how many mg the patient needs. Finally, divide the number of mg needed by the concentration of drug you have (i.e. 250mg tablet or 50mg/mL). This will give you how many tablets (or mL) the patient needs.

Like in man, the medications to use is based on effect you seek or the location of the infection:

Wound care—Amoxicillin, Cephalexin, Clindamycin or Amoxicillin/clavulanate (Augmentin) are good choices. For deep, penetrating wounds the use of two types of antibiotics is a good idea to prevent tetanus. In these instances, use amoxicillin or Augmentin along with Metronidazole. Injectable Penicillin may also be used for simple wounds.

Dental—Clindamycin or Augmentin

GI— Metronidazole, Sulfa/trim. Note, however, that many cases of diarrhea are self limiting and the dog will get back to normal on its own.

Respiratory—Cephalexin, Augmentin, Sulfa/trim, Ciprofloxacin

Tick-borne disease—Doxycycline for 2 weeks

Acute swelling from insect bite or for itching—Benadryl (diphenhydramine)

Intestinal parasites—Pyrantel pamoate, Fenbendazole

Pain—Aspirin

Medication List

The doses listed are primarily for dogs. You may use them in cats, too, if warranted. Farm animal dosing will be listed as such, if applicable. A good "rule of thumb" (ROT) dose is also listed and roughly provides the right dosing based on body weight without calculating an exact dose each time.

Amoxicillin: 10-30mg/kg PO BID
Simple wounds, UTIs, pneumonia
ROT: one 250mg capsule for a 25 pound dog or 500mg for every 50 pounds

Aspirin: Pain, fever & inflammation
10-25mg/kg PO BID (5mg/lb)
ROT: one 325mg tablet per 55 pounds
-use enteric coated when possible
horses: 25-50mg/kg PO BID

Benadryl: Acute swelling (from insect or snake bite) or for itching from allergies (diphenhydramine)
1mg/lb or 2.2mg/kg
ROT: one 25mg tablet per 25 pounds

Cephalexin: UTI, skin, soft tissue, pneumonia
22-40mg/kg PO BID
ROT: 500mg for every 50 pounds (increase dose if need to)

Ciprofloxacin: Pneumonia, soft tissue, skin, bone, UTI
20-25mg/kg PO SID
ROT: 500mg per 50 pounds

Clindamycin: Dental, skin, respiratory
11-33mg/kg PO BID
ROT: one 150mg tablet per 30 pounds

Doxycycline: Soft tissue, urinary tract, tick-borne disease
3-5mg/kg PO BID for general infections
5mg/kg PO BID for tick-borne disease (10mg/kg/day total) for 14 days
ROT: one 100mg tablet per 50 pounds

Fenbendazole: Broad spectrum dewormer effective against hook-, round- and whip-worms
dogs/cats: 50mg/kg/day PO x 3 days
horses: 5.1mg/kg PO
sheep/goats/cattle: 5mg/kg PO once
-meat withdrawal 8 days

Metronidazole: Diarrhea, for wounds with anaerobic bacteria (tetanus)
12-15mg/kg PO BID
ROT: one 250mg tablet per 30 pounds
-high doses may cause neurologic problems

Oxytetracycline: Respiratory/pneumonia, UTI, soft tissue, skin
cattle/ruminants: 20mg/kg IM as a single dose
Use long-acting formula (LA200)

Procaine Penicillin G: Respiratory, abscesses, UTI
Injectable formula that has a slow release over 12 hours
Give as intramuscular (IM) injection ONLY
-only inject 30mL per site maximum
Observe withdrawal times to prevent food residue
-do not slaughter for meat within 20 days
-discard milk for 4 days
dog/cat: 20,000-40,000 IU/kg IM SID-BID
cattle/goats/sheep: 44,000-66,000 IU/kg IM SID
-may be given intramammary for mastitis
-100,000 IU into each affected quarter ever 12 hours for 3 doses
-milk the cow dry, then use a syringe to administer the PPG through the teat canal into the udder. Massage the medication around and leave it for 6 hours before milking.

pigs: 15,000-25,000 IU/kg IM SID
horses: 22,000-44,000 IU/kg IM BID

Pyrantel pamoate: Dewormer effective against hookworms & roundworms
dogs: 5mg/kg PO once
cats: 20mg/kg PO once
horses: 13.2mg/kg PO once
pigs: 22mg/kg PO once

Sulfa/trim: (sulfonamide with trimethoprim)
Respiratory, soft tissue, wounds, abscesses, UTI
15-30mg/kg PO BID
horses: 30mg/kg PO BID (25mg sulfonamide + 5mg trimethoprim)

End Note

This book is about medicine at the end of the world.

What we discuss has only limited applicability to the current time and while having a degree of independence in your health care is good, this book is designed for where/when the help isn't coming or available and the grid is down. It is not designed for use in a grid up First World country – there will almost always be better and safer options than many described in this volume.

Diseases, illness and injury can kill or maim you.

Prevention is better than cure.

If you cannot prevent them, then a basic knowledge and limited equipment or drugs can be lifesaving or minimize the diseases impact.

Nothing is risk free!

Practicing medicine as an educated layman can be a highly risky activity.

At the end of the day you need to decide if the risk to the patient from the disease, exceeds the risk to the patient from receiving care from a provider with limited training or experience.

Often there will be no perfect answer. You must always act in the patient's best interest.

Always ask if doing nothing is preferable to doing something and, most of all, do no harm.

Good luck!

Last Minute Additions

Just prior to the publication of this book, the authors identified two areas we had not covered adequately. We have added them here, at the end of the book, we hope you find them useful.

Ch. 3 Organizational issues addition

Medical trade and barter

What is it worth to traction, set and splint a broken thigh bone? What about a course of 5-year-old antibiotic tablets for someone with a bad respiratory infection?

Potentially quite a lot!

Historically 'healers' have had substantial value in their communities. The local doctor, while not usually part of the upper class throughout history, has always been a safe and solid member of the middle class – nice accommodations, reasonable access to good quality food, access to education for your children and safety. That is because of the inherent value of good (or bad!!) quality medical care. Ultimately throughout history, medical knowledge and skills bought choices and options. In a primitive or agrarian society, choices and options could be the difference between life or death.

Within your own group being the medic is just another team role of no more or less importance than many other roles. However, within a wider community a healer has significant inherent value due to their ability to deliver potentially lifesaving or altering health care. Don't underestimate the value of direct medical care and wider public health interventions within a community or a district.

Using your skills and knowledge as for barter.

Many people are medically ignorant. Basic medical concepts are often simple and straight forward – 'don't poo in your drinking water' – yet time and time again the basics are ignored or not known. In the third world setting, poor water quality is a big issue and disease as a direct consequence of human waste in drinking water accounts for much illness and death. But this isn't just a third world problem! There are many cases of first world, intelligent, educated people going on a camping trip and washing themselves or defecating in their camp water supply, exposing themselves or others to significant risk. Knowing the simple fact that a latrine area cannot have run-off into a drinking water area is simple, but frequently forgotten. The ability to offer a preventative medicine assessment to a group is invaluable, as it prevents disease (and associated days not available for productive work) and death.

Medical knowledge and the ability to apply it in a common sense / pragmatic way is potentially worth its weight in gold and is a valuable trade item. But what is knowledge worth? How much do you charge for a consultation or to share your knowledge?

Your approach to this is something you will have to determine based on your ethical view of the world and how you see your role evolving. One view is that health is a common good or even a right and you should make it as widely and as cheaply available as possible. Another is that it another good like any other and the 'market' decides on its value and you should 'sell it' for what it is worth. The authors' view is somewhere in the middle of these two positions –free access to the basics of health care when logistically possible is reasonable (when not at large cost to another), but providing that health care has value and as the provider you and your family / group should derive some benefit from your knowledge and skills. Ultimately it is up to you to decide where you sit on this issue and how you value it.

Using medical goods for barter.

The simple message here is 'think twice before you do'. It is likely that medical stores and medications (even expired ones) will have a high intrinsic value. Bartering medical supplies is both a commercial and an ethical process:

a. These items have high value due to scarcity and lack of ability to substitute
b. These items are potentially lifesaving
c. Once they are gone replacement is probably not possible

The simple argument is that failure to stockpile medical supplies is no different than failing to stockpile food, and to give it away is no different than not giving away your food. Many, for religious or simply for moral reasons have some food supplies dedicated for charity – it is entirely reasonable to take this approach with medical supplies as well. However, always consider the above three comments.

In terms of easily tradeable and high value tradable items consider:

Most common medication for acute illness and injury
- Simple 'over the counter' Analgesic (pain killing) agents
- Indigestion remedies
- Constipation treatments
- Antihistamines
- Antibiotics **

Betadine and other antiseptics and disinfectants
Dressings and bandages
Soap and toothbrushes

Be very careful trading irreplaceable supplies. Trading things you can make or produce is one thing, but trading away items that are essentially irreplaceable is potentially a bad decision. From a trade perspective, you need to make sure the item(s) you get in return are worth it you or your group.

** We remain unconvinced about using antibiotics (even old expired ones) as trade goods – in a prolonged grid-down situation their importance and value will potentially exceed that of ammunition or gold. Think very carefully about trading away antibiotics – they are likely irreplaceable and one day may be indispensable.

Ch. 7 Clinical FAQ addition.

Q. While we were hunting, my friend was bitten by ticks. Is there anything to worry about?

Yes. There are two things to worry about:

1. Tick-borne diseases' particularly Lyme disease.
2. Infection of the bite site – skin infections / infected bites and wounds are covered elsewhere in the FAQ chapter and the Wound chapter. These are relatively uncommon.

Lyme disease is a tick transmitted infection caused by the bacteria Borrelia burgdorferi. Not all ticks can carry the bacteria and it is generally transmitted by deer ticks of Ixodes species. There are occasional case reports of Lyme disease all over North America, but the clear majority of infections are confined to the North East and North Central areas. There is some controversy around the extent of potential distribution of the disease, with some suggesting it is much more extensive but this is generally not supported by infectious disease experts or the CDC.

There are some proponents of using antibiotics in anybody who has been bitten by a tick to try to prevent infection with Lyme disease. In an austere environment, this is likely to not be a practical or appropriate use of limited antibiotics. In someone who has been bitten by ticks in an at-risk area, you should stay alert of signs of Lyme disease for 30 days.

The presentation of Lyme disease can be complex and it can mimic many other diseases. The biggest red flag of potential infection is becoming unwell – rashes, headaches, muscle and joint aches etc, within 30 days of a tick bite. Complicating this is the fact 60-70% of patients confirmed with Lyme disease don't recall a tick bite.

Early Lyme disease is characterized by a rash around the site of the tick bite and multiple patchy red rash lesions with a pale central area – known as Erythema migrans.

It can also present with a type of meningitis (infection around the brain) or an inflammation of the heart muscle – diagnosing both in an austere environment can be a challenge and relies on you or the patient being able to relate the current illness to a tick bite in a high-risk region for infection.

erythematous rash around the central tick bite. wikicommons

multiple erythema migrans lesions.

Late presentations can be more of a challenge as they can occur much later than the initial tick bite. It can present as a severe arthritis (joint inflammation) involving multiple joints around the body or as a chronic meningitis – presenting with headaches, thinking problems and sleepiness. It should be considered as a diagnosis in patients presenting like this, in an area where Lyme disease is present. A detailed history should be taken looking for a history of bites or of a transient rash which may have come and gone quickly.

Treatment:

Ticks should be removed as sonn as they are noticed. Use tweezers to grab the neck of the tick right at the level of the skin. Pull slightly until the skin is tented. Hold that position until the tick lets go. Make sure the head is still attached to the body.

The standard treatment for early Lyme disease is Doxycycline 100mg BD PO 10 days or Amoxicillin 500mgPO TDS for 14 days. Recommendations vary somewhat about the treatment of late presentation of the disease in terms of the length of the antibiotic treatment – most recommendations suggest 14 days is sufficient.

Should you have sufficient resources to treat every patient presenting with a tick bite in a high-risk area the recommended treatment is Doxycycline 200mg as a single dose.

Other tick-borne diseases: There are several other diseases spread by ticks across the United States and other parts of the world, but Lyme's disease is by far the most common. Other diseases include Rocky Mountain Spotted Fever, Ehrlichiosis and babesiosis, but there are others. Though the clinical signs for other infections may be slightly different than Lyme's, the treatment for them is overall the same—doxycycline as noted above. The important part is to recognize a tick-borne disease early in the infection and treating with antibiotics immediately. If a tick-borne disease is not treated early on, the patient may need a longer course of antibiotic treatment (2-4 weeks) and there is a possibility they will be affected for life.

Prevention: It is much more effective to prevent tick bites than to try to treat potential disease. Whenever possible, wear insect repellent when working outdoors and always check yourself for ticks after you come inside. Removing an attached tick early may prevent infection. Dogs & cats can also be a host for ticks and may bring them inside your home. Keep pets on prevention or keep them outdoors to protect yourself.

Medicine at the End of the World

With the breakdown of infrastructure, access to advanced medical help would be, at best, limited. Poor hygiene & disrupted water supplies would lead to an increase in diseases such as typhoid fever and cholera. People suffering from chronic illnesses such as asthma, diabetes, or epilepsy would be severely affected, with many dying. With no antibiotics, there would be no treatment for bacterial infections— pneumonia or a simple cut could kill again and high mortality rates would be associated with any surgery. The same would apply to painkillers— a broken leg would be agony, and dying of cancer would be distressing for both the patient and their family. Vaccine preventable diseases would make a comeback— polio, tetanus, whooping cough, diphtheria and mumps would be commonplace again. In the absence of oral contraceptives or condoms the pregnancy rate would rise and, with it, the maternal and neonatal death rates. Teeth would rot without proper dental care and painful extractions would have to be performed without anaesthesia. The limited medical supplies available would have to be recycled, resulting in an increase in the spread of hepatitis and HIV infection.

We take health care for granted.

We wish to provide you with the knowledge needed to approach health care after large scale, long-term, grid-down disaster. This book will equip you to deal with many common medical problems when modern health care facilities are not available.

—**The Remote, Austere, Wilderness & Third World Medicine Forum Moderators**

Austere: (of living conditions or a way of life) having no comforts or luxuries.

&

Survival: Continuing to live or exist, typically in spite of an accident, ordeal or difficult circumstances.

Medicine: The science or practice of the diagnosis, treatment & prevention of disease.

Definitions adapted from the Oxford living dictionary.